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NOESIS

Technical Magazine

Department of

Mechanical Engineering

Year 2021-22

Vol-1, Issue -1

Hon. Shri. Anil Bagane
Executive Director

Executive Director's Message

I am very happy to know that Mechanical Engineering Department of Sharad Institute of Technology is bringing out the sixth edition of technical Magazine 'NOESIS' for the year 2021-2022 . In the age of globalization, to build a truly different institution of engineering and technology, our aim is to build an effervescent community of engineers, where faculty and students are cronies in a mutually inspirational education process, engrossed in learning. This learning process would lead to the inventions and then to discoveries. We actively seek to engage our adjacent associates from research and educational institutions, to contribute in the process of learning by sharing their proficiency and practices gained outside of the classroom. However, advances in the fields have resulted in significant developments in all streams of technology, which in turn, has had a tremendous impact on the way research, is conducted. We are trusted to nurturing juvenile minds and preparing them for challenges in today's globalised technology. The doors of our faculty members are always open for any student who seeks help.

We persuade all the students to use their time with professors and teaching staff fruitfully, to develop their own proficiency. Sharad Institute of Technology has made all efforts towards the core areas of excellence in Technology with facilitating research efforts. I am sure that this technical magazine play important role to improve technical knowledge of students of mechanical engineering department. Wish you all the best.

Dr. S. A. Khot
Principal

Principal's Message

It gives me great pleasure to know that 'NOESIS', Sharad Institute of technology college of engineering, college magazine2021-2022 is ready for publication. True to its name, this magazine gives an insight into the range and scope of the imagination and creativity of our students and faculty members. I applaud the editorial team for the hard work and dedication they have invested in realizing this goal, and wish my dear students success in all future endeavors. I wish a very best of luck to the team of Technical Magazine.

Dr. P. M. Bhagwat
HOD, Mechanical

HoD's Message

I am delighted to learn that our department is bringing out a magazine for this academic year. It is a nice platform for both the faculty and the students to exhibit their talents. I strongly believe that it would be an excellent medium through which the world can learn about the potential and achievements of NOESIS. I hope that this would be an ongoing process and the magazine would bring out the latent talent of everyone. I join others in appreciating and recognizing the hard work of the editors and the magazine committee in bringing out the magazine and in wishing them success in their endeavor.

Mr. A. S. N. Husainy
Mechanical Engineering
Department

Editor’s Message

It gives us great pleasure to bring you the first issue of NOESIS, the department magazine of SITCoE. The name and fame of an institute depends on the caliber and achievements of the students and teachers. The role of a teacher is to be a facilitator in nurturing the skills and talents of students. This magazine is a platform to exhibit the literary skills and innovative ideas of teachers and students. We would like to place on record our gratitude and heartfelt thanks to all those who have contributed to make this effort a success. We profusely thank the management for giving support and encouragement and a free hand in this endeavor. We are thankful to all and truly hope that the pages that follow will make an interesting read.

INTRODUCTION TO SOLAR COOKER

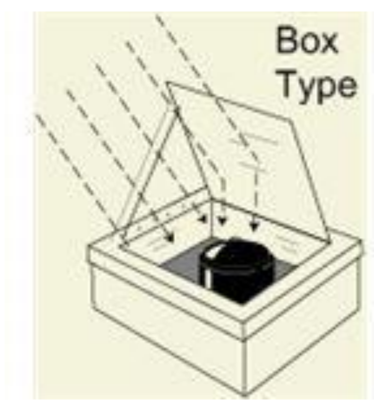
JADHAV AMEY AMIT, MADAKE HRUTUJA AJIT, BHANUSE SANTOSH SHIVAJI, FAKIR YOUNUS AAKRAM

Solar cookers use sunlight for cooking, drying and pasteurization. They can be grouped into three broad categories: box cookers, panel cookers and reflector cookers. The simplest solar cooker is the box cooker first built by Horace de Saussure in 1767.

This device uses the rays of the sun and converts it into heat energy for heating the food. The solar cooker uses the energy of the sun directly for preparing food just like the plants that use sunlight to prepare their food. Solar cookers are cheap and use no fuel because of which many people in developed and developing countries make use of it. Solar cookers are mainly used when the food is prepared outdoor and helps in lowering pollution and deforestation.

TYPES OF SOLAR COOKER:

- **Box Type Solar Cookers**

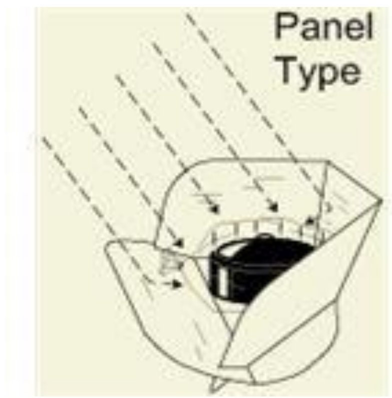


These are most widely used type of solar cookers. They can be rectangular or circular in shape. The box type of solar cooker comprises of the enclosed space where the vessel containing the raw food is kept. At the top of the box there is a glass that allows the sunrays to pass through it and get concentrated inside the box.

There are two methods of cooking the food. In first type the concentrated sunrays directly fall of the cooking vessel and cook the food. In the second method, a black surface is applied in the inner surface of box, which absorbs the sunrays and converts it into heat thus heating the food and creating a mini greenhouse effect. In either case the box is covered with the insulating material to avoid heat leaking out.

Although box cookers are slow they provide even heating of the food. Box types of solar cookers are easy to make and use, safe, and cheap.

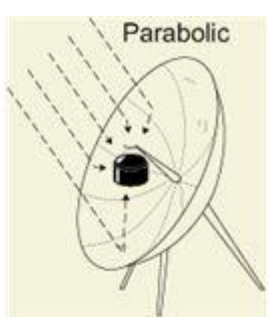
- **Panel Type of Solar Cookers**



These are very cheap solar cookers, and the easiest to construct. These are also known as CooKit models. Panel solar cookers comprise of four panels, which are covered with a reflective material like aluminum foil. Sunlight falling on the panels is reflected to the middle portion of the box formed by the panels, where the cooking vessel is kept. Due to concentrated sunrays the food gets heated and cooked. The panels are ordinary cardboard on which the aluminum foil, similar to the one found in cigarette packets, is applied.

- Although they are easy to make, they are less effective in windy atmospheres as the heat will be blown away. They are also not able to absorb sufficient quantity of heat in cloudy atmosphere.

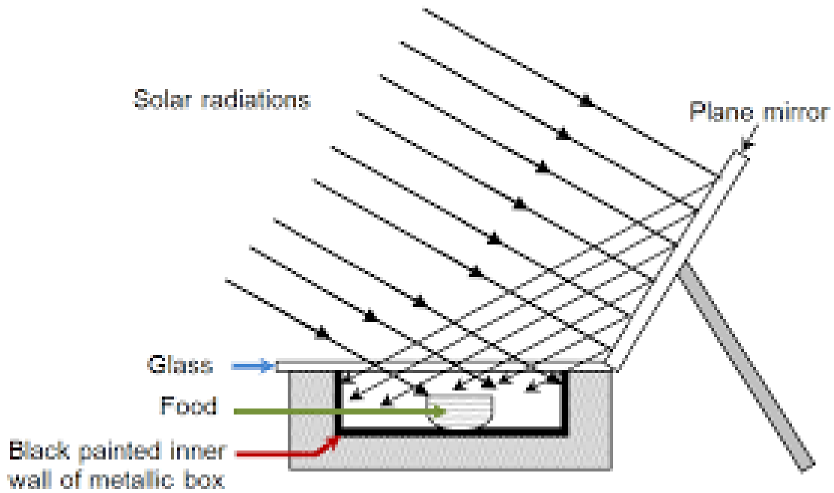
Parabolic Type of Solar Cookers



The parabolic type of solar cooker comprises of reflective metal sheets joined together to form an umbrella sort of shape. When the sunrays fall on the metal sheets the energy is concentrated into a small area, where the cooking vessel is placed. In the parabolic solar cooker solar energy is highly concentrated; hence they are the fastest type of all the solar cookers.

The parabolic type of solar cookers requires precision design so that the solar energy gets concentrated at the exact right place. If the concentrated energy does not falls on the cooking vessel, the food will not cook efficiently.

PRINCIPLES OF SOLAR COOKING:



Box type solar cooker

1) Concentrating sunlight: A mirrored surface with high specular reflectivity is used to concentrate light from the sun on to a small cooking area. Depending on the geometry of the surface, sunlight can be concentrated by several orders of magnitude producing temperatures high enough to melt salt and smelt metal. For most household solar cooking applications, such high temperatures are not really required. Solar cooking products, thus, are typically designed to achieve temperatures of 150 °F (65 °C) (baking temperatures) to 750 °F (400 °C) (grilling/searing temperatures) on a sunny day.
2) Converting light energy to heat energy: Solar cookers concentrate sunlight onto a receiver such as a cooking pan. The interaction between the light energy and the receiver material converts light to heat. This conversion is maximized by using materials that conduct and retain

heat. Pots and pans used on solar cookers should be matte black in color to maximize the absorption.

3) Trapping heat energy: It is important to reduce convection by isolating the air inside the cooker from the air outside the cooker. Simply using a glass lid on your pot enhances light absorption from the top of the pan and provides a greenhouse effect that improves heat retention and minimizes convection loss. This "glazing" transmits incoming visible sunlight but is opaque to escaping infrared thermal radiation. In resource constrained settings, a high-temperature plastic bag can serve a similar function, trapping air inside and making it possible to reach temperatures on cold and windy days similar to those possible on hot days.

CONSTRUCTION:

Before going to make a solar cooker, we have some requirements which are as follows:

- A dark colored pot preferably black.. A dark pot is required because a dark object gets heartened up quickly.
- We then require a large glass or a transparent covering that will allow the rays of the sun to reach the dark cooking pot inside which food is kept. This helps in increasing the temperature and also prevents the heat from escaping out.,which again helps in trapping the rays of the sun and helps the food to get cooked.
- We also require an extra material that will help you increase the sunlight inside the cooking pot. A mirror is generally used for this purpose as it can reflect the sunlight inside the cooker. Apart from a mirror an aluminum foil too can be used.
- The more the sun rays the more the heat and faster the food gets cooked.

REFERENCES:

- “Solar Energy” by S. P. Sukhatme
- “Renewable Energy”Sources by G. D. Rai.

ANALYSIS OF PARAMETERS OF CRYOGENIC GRINDING PROCESS OF PLASTIC

VIRBHADRE OM SHASHIKANT, SHAIKH SAYEEDAHMED M, TONE MAYURESH SANJAY, PATIL NAMRATA SANTOSH

The term plastic refers to a family of material, which includes PVC, nylon, polyethylene and polypropylene just as zinc-aluminum, copper and steel falls in the family of metals. This is an important point because just as zinc has quite different properties from nylon, few designers would simply specify metal as a material for particular component so it would be equally unsatisfactory just to recommend plastic. This analogy can be taken still further because in some way that there are different grades of steel. There are different grades of PVA, nylon, polypropylene. In both cases designer will recognize these and select the most appropriate material and grade on the basis of process ability, toughness, chemical resistance etc.

It is usual to think that plastics are recently developed but in fact as a part of the large family called polymers. They are basic ingredients of plant life and polymers are different in sense that their structure consists of large and long chain like molecules, natural materials like silk, cotton, shellac, bitumen rubber and cellulose have this type of structure.

During early 20th century there was a considerable interest in new synthetic materials, phenol formaldehyde was introduced. During Second World War nylon, polyethylene and acrylic appeared on scene. Initially plastics are being treated as cheap substitutes but now days the special properties of plastics are being appreciated, which are establishing them as important materials in their own right. The over increasing use of plastics in all kind of applications means that it is essential for designers and to engineers to become familiar with the range of plastics available and types of performance characteristics to be expected so that these can be used to the best advantage.

PLASTICS AVAILABLE TO THE DESIGNER

Plastics, more than any other design material, offer such a wide spectrum of properties that they must be given serious consideration in most component designs. However, this does not mean that there is sure to be a plastic with the correct combination of properties for every application. It simply means that the designer must have an awareness of the properties of the range of plastics available and keep an open mind. One of the most common faults in design is to be guided by preconceived notions. For example, on initial commitment to plastic based on an irrational approach is itself a serious design fault. A good design always involves a judicious selection of a material from the whole range available, including non-plastics. Generally in fact, it is only against a background of what other materials have to offer that the full advantages of plastics can be realized.

ENGINEERING PLASTICS

A useful definition of an engineering material is that it is able to support loads more or less indefinitely. By such a criterion thermoplastics are at disadvantage compared with metals because they have low time dependent module and inferior strengths except in rather special circumstances. However, these rather important disadvantages are offset by advantages such as low density, resistance to many of the liquids that corrode metals and above all, easy process ability. Thus, where plastics compete successfully with other materials in engineering applications it is usually because of favorable balance of properties rather than because of an outstanding superiority in some particular aspect, although the relative ease with which they can be formed in to complex shapes tend to be particularly dominant factor. In addition to conferring the possibility of low production costs, ease of processing permits imaginative designs that often enable plastics to be used as a superior alternative to metals rather than merely as a tolerated substitute.

Journal Reference and books:

1. A. S. Athalye, Identification and Testing of Plastics, Multi-Tech Publishing Company, Bombay.

2. A.S. Athalye, Plastic Material Handbook, Multi-Tech Publishing Company, 1991.

3. A.S.Athaley, Moulding of Plastic, Multi-Tech Publishing Company, Bombay.

4. A.S. Athaley, Procurring of Plastic, Popular Plastics, Mumbai(1991).

5. Birley A.W. & Scott M.J. , Plastic Material and Application.

SMOKE FROM NUCLEAR WAR WOULD DEVASTATE OZONE LAYER, ALTER CLIMATE

PATIL RAJMATI MAHAVEER, CHIKHALE SANKET POPAT, CHOUGULE ABHISHEK VRUSHBH, PALLAVI KONGNULE

The international study paints an even grimmer picture of a global nuclear war's aftermath than previous analyses. The research team used newly developed computer climate modeling techniques to learn more about the effects of a hypothetical nuclear exchange, including complex chemistry interactions in the stratosphere that influence the amounts of ultraviolet (UV) radiation that reach the planet's surface.

"In addition to all the fatalities that would happen almost immediately, the climate effects and the UV effects would be widespread," said lead author Charles Bardeen, a scientist at the National Center for Atmospheric Research (NCAR). "These aren't local to where the war occurs. They're global, so they would affect all of us."

Bardeen and his co-authors found that smoke from a global nuclear war would destroy much of the ozone layer over a 15-year period, with the ozone loss peaking at an average of about 75% worldwide. Even a regional nuclear war would lead to a peak ozone loss of 25% globally, with recovery taking about 12 years.

Since the ozone layer protects Earth's surface from harmful UV radiation, such impacts would be devastating to humans and the environment. High levels of UV radiation have been linked to certain types of skin cancer, cataracts, and immunological disorders. The ozone layer also protects terrestrial and aquatic ecosystems, as well as agriculture.

"Although we suspected that ozone would be destroyed after nuclear war and that would result in enhanced ultraviolet light at the Earth's surface, if there was too much smoke, it would block out the ultraviolet light," said study co-author Alan Robock, a professor of climate science at Rutgers University. "Now, for the first time, we have calculated how this would work and quantified how it would depend on the amount of smoke."

The study was funded by the Open Philanthropy Project with computational support from the National Science Foundation, which is NCAR's sponsor, as well as from the University of Colorado Boulder and Colorado State University. It was published in the *Journal of Geophysical Research -- Atmospheres*, a publication of the American Geophysical Union.

Shifting atmospheric response to global war

Scientists in the 1980s found that the enormous amounts of smoke from a nuclear war would cool the planet by blocking incoming sunlight, an outcome known as a "nuclear winter." They also found that a nuclear war would destroy ozone because of chemical reactions involving nitrogen oxides produced from the fireball created by a nuclear weapon explosion.

Subsequent research, however, suggested that the smoke would also cause ozone loss by heating the stratosphere, which changes chemical reaction rates, and by reducing photochemistry (chemical reactions caused by sunlight).

In the new study, the authors explored how much the reduced photochemistry would affect ozone destruction, as well as the extent to which the smoke would protect the surface from UV radiation. They calculated, for the first time, the combined effects of nitrogen oxides, stratospheric heating, and reduced photochemistry on stratospheric ozone chemistry and surface UV resulting from a global nuclear war.

The research team combined four advanced NCAR-based computer models: the Community Earth System Model, which simulates global climate; the Whole Atmosphere Community Climate Model, which simulates higher regions of the atmosphere; the Tropospheric Ultraviolet and Visible Radiation Model, which calculates the light available for photolysis and the amount of UV radiation that reaches the surface; and the Community Aerosol and Radiation Model for Atmospheres, which provides an advanced treatment of smoke particles.

They used this modeling approach to study two scenarios. In one, a regional nuclear war between India and Pakistan produces 5 megatons of smoke. In the other, a global nuclear war between the United States and Russia produces 150 megatons of smoke.

The results highlighted the importance of using sophisticated modeling techniques to flesh out the complexities of the atmosphere. In the case of the global nuclear war, for example, the simulations showed that massive injection of smoke into the stratosphere would initially cool surface temperatures by blocking sunlight, alter precipitation patterns, shield the planet from incoming UV radiation, while also destroying the protective ozone layer. Within a few years, however, the smoke would begin to dissipate and far more UV radiation would reach the surface through the diminished ozone layer.

"Conditions would switch dramatically, and adaptations that may work at first won't help as temperatures warm back up and UV radiation increases," Bardeen said. "Just as the smoke is clearing up, you would get this blast of UV with completely different impacts on human health and agriculture."

In contrast, a regional nuclear war that generated less smoke would result in a more straightforward pattern, with UV increasing right away while surface temperatures are decreasing and the ozone layer gradually recovering as the smoke dissipates.

Journal Reference:

1. Charles G. Bardeen, Douglas E. Kinnison, Owen B. Toon, Michael J. Mills, Francis Vitt, Lili Xia, Jonas Jägermeyr, Nicole S. Lovenduski, Kim J. N. Scherrer, Margot Clyne, Alan Robock. **Extreme Ozone Loss Following Nuclear War Results in Enhanced Surface Ultraviolet Radiation**. *Journal of Geophysical Research: Atmospheres*, 2021; 126 (18) DOI: 10.1029/2021JD035079

USING ARTIFICIAL INTELLIGENCE FOR EARLY DETECTION AND TREATMENT OF ILLNESSES

KAMBLE PRATIK SUDHAKARBAGAL VARDHAN SANDIP, DIYA SANADI, ADITYA AMANE, DHALE ANIKET ANIL, ADITYA DIWATE

Artificial intelligence (AI) will fundamentally change medicine and healthcare: Diagnostic patient data, e.g. from ECG, EEG or X-ray images, can be analyzed with the help of machine learning, so that diseases can be detected at a very early stage based on subtle changes. However, implanting AI within the human body is still a major technical challenge. TU Dresden scientists at the Chair of Optoelectronics have now succeeded for the first time in developing a bio-compatible implantable AI platform that classifies in real time healthy and pathological patterns in biological signals such as heartbeats. It detects pathological changes even without medical supervision. The research results have now been published in the journal Science Advances.

In this work, the research team led by Prof. Karl Leo, Dr. Hans Kleemann and Matteo Cucchi demonstrates an approach for real-time classification of healthy and diseased bio-signals based on a biocompatible AI chip. They used polymer-based fiber networks that structurally resemble the human brain and enable the neuromorphic AI principle of reservoir computing. The random arrangement of polymer fibers forms a so-called "recurrent network," which allows it to process data, analogous to the human brain. The nonlinearity of these networks enables to amplify even the smallest signal changes, which -- in the case of the heartbeat, for example -- are often difficult for doctors to evaluate. However, the nonlinear transformation using the polymer network makes this possible without any problems.

In trials, the AI was able to differentiate between healthy heartbeats from three common arrhythmias with an 88% accuracy rate. In the process, the polymer network consumed less energy than a pacemaker. The potential applications for implantable AI systems are manifold: For example, they could be used to monitor cardiac arrhythmias or complications after surgery and report them to both doctors and patients via smartphone, allowing for swift medical assistance."The vision of combining modern electronics with biology has come a long way in recent years with the development of so-called organic mixed conductors," explains Matteo Cucchi, PhD student and first author of the paper. "So far, however, successes have been limited to simple electronic components such as individual synapses or sensors. Solving complex tasks has not been possible so far. In our research, we have now taken a crucial step toward realizing this vision. By harnessing the power of neuromorphic computing, such as reservoir computing used here, we have succeeded in not only solving complex classification tasks in real time but we will also potentially be able to do this within the human body. This approach will make it possible to develop further intelligent systems in the future that can help save human lives."

Story Source:

Materials provided by TechnischeUniversität Dresden. Note: Content may be edited for style and length.

Journal Reference:

Matteo Cucchi, Christopher Gruener, Lautaro Petrauskas, Peter Steiner, Hsin Tseng, Axel Fischer, Bogdan Penkovsky, Christian Matthus, Peter Birkholz, Hans Kleemann, Karl Leo. Reservoir computing with biocompatible organic electrochemical networks for brain-inspired biosignal classification. Science Advances, 2021; 7 (34): eabh0693
DOI: 10.1126/sciadv.abh0693

HOW TO DECREASE THE MASS OF AIRCRAFTS

HARSH JEETENDRA CHAVAN, KAMATE TANMAY, ROHAN MAHAJAN, PALLAVI PATIL, KOMAL PATIL

Members of the Department of Chemistry of Lomonosov Moscow State University have created unique polymer matrices for polymer composites based on novel phthalonitrile monomers. The developed materials possess higher strength than metals, which helps to sufficiently decrease the mass of aircraft parts that operate at high temperatures. Scientists have published the project results in the Journal of Applied Polymer Science.

A team of scientists from the Chair of Chemical Technology and New Materials at Lomonosov Moscow State University lead by Alexey V. Kepman, a Leading Researcher, is working on developing structural polymer composite materials. They are used for production of various constructions, vehicle components, and structural elements exploited under loading. Aerospace industry, where material requirements are much higher, requires high performance polymer composites. Polymer composites are made of a polymer matrix and a reinforcement material (filling agent) that remain separate and distinct within the finished structure. For example, in carbon fiber reinforces composites (CFRP) carbon fabrics are used as a reinforcing agent while polyester or epoxy resins, bismaleimides, polyimides, and many other polymers -- as a matrix.

A modern airplane e.g. Boeing 787 Dreamliner consists of polymer composites for 50%, and a fighter aircraft Eurofighter of FRP for 70%. Development of high-temperature polymer composites will allow replacing the existing metal engine parts (for instance, low-pressure jet compressor blades) or supersonic aircraft body elements with polymer composite parts.

Chemists have applied a new approach to molecular design of bis-phthalonitrile monomers that are used as starting materials for polymer matrices. They have also developed materials with improved processing requirements suitable for cost-effective injection methods for CFRP manufacturing which is uncommon for most phthalonitriles known to date. Such methods allow to produce high-integrity CFRP parts of complex shape with minimal junction of elements.

The project members Boris Bulgakov and Alexander Babkin say: "At the moment the operating temperature of polymer composite applications reaches up to no more than 150 °? for most popular materials and up to 250 °? For high temperature ones. And we have developed polymer composites with epoxy-like processing, appropriate for operation at elevated temperatures up to 450 °?."

One kilogram of titanium or aluminum alloy nowadays is much cheaper than the same amount of polymer composite (8-10 times less). However, according to Boris Bulgakov, production and maintenance of large complex shape parts made of polymer composites is hugely cheaper. Cost-effectiveness becomes possible due to a significant decrease of labor requirements for the assembly process and a high level of integrity of the resulting structures made of carbon fiber.

Boris Bulgakov explains: "For instance, a wing made of polymer composites is assembled by junction of 10 elements and a wing made of metal of 100 elements. This means that construction of a metal wing costs more. Moreover, strength of CFRP is 6-8 times higher than that of aluminum and at the same time CFRP density is 1.5 times lower."

Polymer composites are widely used for production of premium automobiles, Formula-1 racing bolides, airplanes, and spaceships. Weight decrease in the case of airplanes results in fuel economy and increased aircraft useful load. Thus, the production cost of polymer composites is compensated by a reduction of fuel consumption and an increase in cargo capacity. Besides that, polymer composites are less expensive to maintain since they are not susceptible to corrosion.

Development of the new matrices for polymer composites has been conducted in the framework of the Federal Target Program "Research and Development in the Priority Areas of Development of the Russian Scientific and Technological Complex for 2014 -- 2020." Professor V.V. Avdeev, the head of the Chair of Chemical Technology and New Materials has set a goal to organize pilot production of phthalonitrile resins. The resin samples, synthesized at Lomonosov Moscow State University, are under investigation at P. I. Baranov Central Institute of Aviation Motor Development, A.N. Tupolev Kazan National Research Technical University and other organizations.

Story Source:

Materials provided by **Lomonosov Moscow State University**.Note: Content may be edited for style and length.

Journal Reference:

1. B. A. Bulgakov, A. V. Sulimov, A. V. Babkin, A. V. Kepman, A. P. Malakho, V. V. Avdeev. **Dual-curing thermosetting monomer containing both propargyl ether and phthalonitrile groups**. Journal of Applied Polymer Science, 2017; 134 (18) DOI: 10.1002/app.44786

ONE-DIMENSIONAL CRYSTALS FOR LOW- TEMPERATURE THERMOELECTRIC COOLING

KULKARNI MANASI PRASAD, SHETTY MAYUR MOHAN, SHETTY MAYUR MOHAN, SHIROLE SHUBHAM SANJAY, AGALAVE AMRUTESH, SHUBHAM PAWAR, ARIF JINDI, AMAN PATEL, SAHIL BUJRUK

Thermoelectric cooling is a solid-state refrigeration process where the heat in an electrically conductive material is transferred using the material's own conduction electrons without any need for the gaseous coolants, such as chlorofluorocarbons, that are used in conventional refrigeration. Coolers based on thermoelectric technology can be scaled down in size without changing their thermal-to-electrical energy conversion efficiency and this is a major advantage for localized cooling of tiny electronic devices. This effect is already used for temperature control in devices such as infrared sensors and laser diodes, and has also been used to provide low-temperature refrigeration for cryogenic electronic devices like superconducting sensors.

However, the lack of materials with suitable thermoelectric efficiency for practical cooling applications at temperatures below 250 K (approximately -23°C) has driven researchers at Nagoya University to look at the effectiveness of new compounds for truly low-temperature applications."We studied the thermoelectric properties of whisker-like crystals composed of a compound of tantalum, silicon and tellurium," says corresponding author Yoshihiko Okamoto from Nagoya University's Department of Applied Physics. "These crystals produced very high thermoelectric powers over a wide temperature range, from the cryogenic level of 50 K (which is around -223°C) up to room temperature, but still maintained the low electrical resistivity that is needed for practical cooling applications." The samples that were grown for the experiments included pure Ta_4SiTe_4 and other crystals that were chemically doped with low levels of molybdenum and antimony.

Various material properties were measured for the samples, including thermoelectric power, electrical resistivity, and thermal conductivity, to compare the effects of the two dopants on their thermoelectric characteristics. "We measured a very high thermoelectric power factor at an optimum temperature of 130

K," adds Okamoto. "However, this optimum temperature could be controlled over a very broad range by varying the chemical doping, and indicates that these crystals are suitable for practical low-temperature use."Addition of as little as 0.1% molybdenum doping caused the resistivity of the telluride-type crystals to decrease dramatically at low temperatures, while they also demonstrated high thermoelectric powers that were closely related to the strongly one-dimensional electronic structures of the materials. The power factors of the crystals at room temperature greatly exceeded the corresponding values of the conventional Bi_2Te_3-based alloys that are commonly used in thermoelectric applications, and these crystals thus represent a highly promising route towards the development of high-performance thermoelectric cooling solutions at very low temperatures.

Story Source:

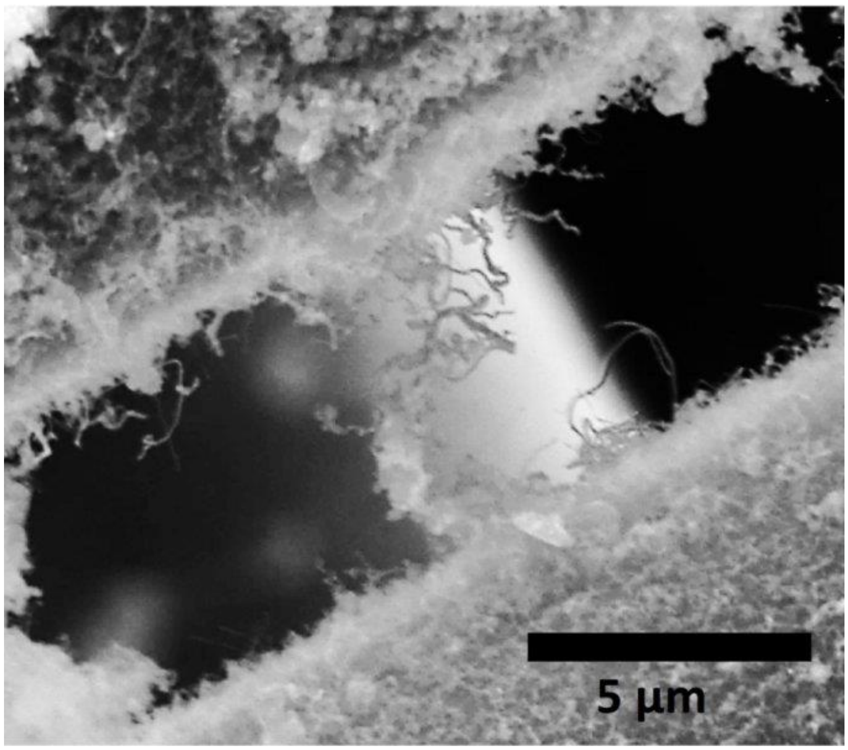
Materials provided by **Nagoya University**. Note: Content may be edited for style and length.

Journal Reference:

1. Takumi Inohara, Yoshihiko Okamoto, YouichiYamakawa, Ai Yamakage, KoshiTakenaka. **Large thermoelectric power factor at low temperatures in one-dimensional telluride Ta4SiTe4**. Applied Physics Letters, 2017; 110 (18): 183901 DOI: 10.1063/1.4982623

'FUZZY' FIBERS CAN TAKE ROCKETS' HEAT

BHAGATE AKSHATA SUNIL,NIKHIL BANDA HATALGE, CHAKOTE KOMAL SANJAY, MANE NIKITA SHITAL, JAGTAP BHUSHAN BHANUDAS, VAISHNAVI BANDGAR, KUPADE KRISHNA



Silicon carbide nanotubes attached to separate silicon carbide fibers, used by NASA, entangle each other in this electron microscope image. The material created at Rice University is intended for a ceramic composite that would make rocket engines stronger, lighter and better able to withstand extreme heat.To stand up to the heat and pressure of next-generation rocket engines, the composite fibers used to make them should be fuzzy.

The Rice University laboratory of materials scientist PulickelAjayan, in collaboration with NASA, has developed "fuzzy fibers" of silicon carbide that act like Velcro and stand up to the punishment that materials experience in aerospace applications.

The fibers strengthen composites used in advanced rocket engines that have to withstand temperatures up to 1,600 degrees Celsius (2,912 degrees Fahrenheit). Ceramic composites in rockets now being developed use silicon carbide fibers to strengthen the material, but they can crack or become brittle when exposed to oxygen.

The Rice lab embedded silicon carbide nanotubes and nanowires into the surface of NASA's fibers. The exposed parts of the fibers are curly and act like the hooks and loops that make Velcro so valuable but on the nanoscale.

The result, according to lead researchers Amelia Hart, a Rice graduate student, and Chandra SekharTiwary, a Rice postdoctoral associate, creates very strong interlocking connections where the fibers tangle; this not only makes the composite less prone to cracking but also seals it to prevent oxygen from changing the fiber's chemical composition.The work is detailed in the American Chemical Society journal Applied Materials and Interfaces.

The work began when Hart, who had been studying the growth of carbon nanotubes on ceramic wool, met Michael Meador, then a scientist at NASA's Glenn Research Center, Cleveland, at the kickoff reception for Rice's Materials Science and NanoEngineering Department. (Meador is now nanotechnology project manager at NASA's Game Changing Technologies program.)

That led to a fellowship in Cleveland and the chance to combine her ideas with those of NASA research engineer and paper co-author Janet Hurst. "She was partially converting silicon carbide from carbon nanotubes," Hart said. "We used her formulation and my ability to grow nanotubes and figured out how to make the new composite."

Back at Rice, Hart and her colleagues grew their hooks and loops by first bathing silicon carbide fiber in an iron catalyst and then using water-assisted chemical vapor deposition, a process developed in part at Rice, to embed a carpet of carbon nanotubes directly into the surface. These become the template for the final product. The fibers were then heated in silicon nanopowder at high temperature, which converts the carbon nanotubes to silicon carbide "fuzz."

The researchers hope their fuzzy fibers will upgrade the strong, light and heat-resistant silicon carbide fibers that, when put in ceramic composites, are being tested for robust nozzles and other parts in rocket engines. "The silicon carbide fiber they already use is stable to 1,600 C," Tiwary said. "So we're confident that attaching silicon carbide nanotubes and wires to add strength will make it even more cutting-edge."

The new materials should also make entire turbo engines significantly lighter, Hart said. "Before they used silicon carbide composites, many engine parts were made of nickel superalloys that had to incorporate a cooling system, which added weight to the whole thing," she said. "By switching to ceramic matrix composites, they could take out the cooling system and go to higher temperatures. Our material will allow the creation of larger, longer-lasting turbo jet engines that go to higher temperatures than ever before."

Friction and compression testing showed the lateral force needed to move silicon carbide nanotubes and wires over each other was much greater than that needed to slide past either plain nanotubes or unenhanced fibers, the researchers reported. They were also able to easily bounce back from high compression applied with a nano-indenter, which showed their ability to resist breaking down for longer amounts of time.

Tests to see how well the fibers handled heat showed plain carbon nanotubes burning away from the fibers, but the silicon carbide nanotubes easily resisted temperatures of up to 1,000 C.

Hart said the next step will be to apply her conversion techniques to other carbon nanomaterials to create unique three-dimensional materials for additional applications.

Story Source:

Materials provided by **Rice University**. Note: Content may be edited for style and length.

Journal Reference:

1. Amelia H.C. Hart, Ryota Koizumi, John T Hamel, Peter SamoraOwuor, Yusuke Ito, SehmusOzden, SanjitBhowmick, Syed Asif Syed Amanulla, Thierry Tsafack, KunttalKeyshar, Rahul Mital, Janet Hurst, Robert Vajtai, Chandra SekharTiwary, Pulickel M Ajayan. **Velcro®-Inspired SiC Fuzzy Fibers for Aerospace Applications**. ACS Applied Materials & Interfaces, 2017; DOI: 10.1021/acsami.7b01378

A NEW TOOL FOR DISCOVERING NANOPOROUS MATERIALS

LAL SURAJ JAYSING, PADMA JADHAV, MAGDUM ASHISH ADINATH, MANE PRASAD DEEPAK, KAGWADE ARUN KUMAR, JOSHI BHARGAV BHALACHANDRA, PATIL APURV ANIL, SURAJ HASURE, WASIM MUKJAWAR

Topological differences of top-performing materials for methane storage. Topological data analysis reveals the similarity between structures; each node represents a family of similar materials, while a network between two nodes indicates that they share at least one material. The further apart the nodes are, the more dissimilar the materials. The pictures show examples of nanoporous materials at the edges, and represent the topologically most different materials (red = Si, yellow = O, blue area = Pores).

Materials classified as "nanoporous" have structures (or "frameworks") with pores up to 100 nm in diameter. These include diverse materials used in different fields from gas separation, catalysis, and even medicine (e.g. activated charcoal). The performance of nanoporous materials depends on both their chemical composition and the shape of their pores, but the latter is very difficult to quantify. So far, chemists rely on visual inspection to see whether two materials have similar pores. EPFL scientists, in the framework of NCCR-MARVEL, have now developed an innovative mathematical method that allows a computer to quantify similarity of pore structures. The method makes it possible to search databases with hundreds of thousands of nanoporous materials to discover new materials with the right pore structure. The work is published in Nature Communications.

The search for nanoporous materials

Nanoporous materials comprise a broad category and can differ widely in their chemical makeup. What unites them is the presence of nano-sized pores in their three-dimensional structure, which endows them with catalytic and absorption properties. These pores can range between 0.2-1000 nanometers, and their size and shape (their "geometry") can have a decisive effect on the material's properties. In fact, pore shape is as important a predictor of performance as chemical composition.

Today, computers can generate large databases of potential materials and determine -- before having to synthesize them which materials would perform best for a given application. But their chemistry is so versatile that the number of possible new materials is almost unlimited, while we do not have a method for quantifying and comparing similarity between pore geometries. All this means that finding the best nanoporous material for any given application is challenging.

Math to the rescue

A new method developed in a collaboration of the labs of Berend Smit and Kathryn Hess Bellwald at EPFL uses a technique from applied mathematics called "persistent homology." This technique can quantify the geometric similarity of pore structures by adopting the mathematical tools that are commonly used by Facebook and others to find similar faces in uploaded photos.

The persistent homology method produces "fingerprints," represented by barcodes that characterize the pore shapes of each material in the database. These fingerprints are then compared to compute how similar the pore shapes of two materials are. This means that this approach can be used to screen databases and identify materials with similar pore structures.

The EPFL scientists show that the new method is effective at identifying materials with similar pore geometries. One class of nanoporous materials that would benefit from this innovation are the zeolites and the metal-organic frameworks (MOFs), whose applications range from gas separation and storage to catalysis.

The scientists used methane storage an important aspect of renewable energy as a case study. The new method showed that it is possible to find nanoporous materials that perform as well as known top-performing materials by searching databases for similar pore shapes.

Conversely, the study shows that the pore shapes of the top-performing materials can be sorted into topologically distinct classes, and that materials from each class require a different optimization strategy.

"We have a database of over 3,000,000 nanoporous materials, so finding similar structures through visual inspection is out of the question," says Berend Smit. "In fact, going through the literature, we found that authors often don't realize when a new MOF has the same pore structure as another one. So we really need a computational method. However, while humans are intuitively good at recognizing shapes as the same or different, we needed to work with the math department at EPFL to develop a formalism that can teach this skill to a computer."

"In the field of algebraic topology, mathematicians have formulated the theory of persistence homology in any dimension," says Kathryn Hess. "Previous applications used only the first two of these dimensions, so it's exciting that chemical engineers at EPFL have discovered a significant application that requires the third dimension as well."

Story Source:

Materials provided by **EcolePolytechniqueFédérale de Lausanne**. Note: Content may be edited for style and length.

Journal Reference:

1. Yongjin Lee, Senja D. Barthel, PawełDłotko, S. Mohamad Moosavi, Kathryn Hess, Berend Smit. **Quantifying similarity of pore-geometry in nanoporous materials**. Nature Communications, 2017; 8: 15396 DOI:10.1038/ncomms15396

DISCOVERY OF NEW TRANSPARENT THIN FILM MATERIAL COULD IMPROVE ELECTRONICS AND SOLAR CELLS

LOLE ABHISHEK MARUTI, MAGDUM PRANAV MAHAVEER, MURGUNDE KUBER VARDHMAN, PATIL ABHISHEK ANIL, PATIL VRUSHABH SHITAL, MANASI PATIL, PAWAR AVDOOT NANDKUMAR, POWAR ONKAR SHIVAJI, SHOEB MOMIN, ABHIJIT PATIL

A team of researchers, led by the University of Minnesota, have discovered a new nano-scale thin film material with the highest-ever conductivity in its class. The new material could lead to smaller, faster, and more powerful electronics, as well as more efficient solar cells. The discovery is being published today in Nature Communications, an open access journal that publishes high-quality research from all areas of the natural sciences. Researchers say that what makes this new material so unique is that it has a high conductivity, which helps electronics conduct more electricity and become more powerful. But the material also has a wide band gap, which means light can easily pass through the material making it optically transparent. In most cases, materials with wide band gap usually have either low conductivity or poor transparency.

"The high conductivity and wide band gap make this an ideal material for making optically transparent conducting films which could be used in a wide variety of electronic devices, including high power electronics, electronic displays, touch screens and even solar cells in which light needs to pass through the device," said Bharat Jalan, a University of Minnesota chemical engineering and materials science professor and the lead researcher on the study.

Currently, most of the transparent conductors in our electronics use a chemical element called indium. The price of indium has gone up tremendously in the past few years significantly adding to the cost of current display technology. As a result, there has been tremendous effort to find alternative materials that work as well, or even better, than indium-based transparent conductors.

In this study, researchers found a solution. They developed a new transparent conducting thin film using a novel synthesis method, in which they grew a $BaSnO3$ thin film (a combination of barium, tin and oxygen, called barium stannate), but replaced elemental tin source with a chemical precursor of tin. The chemical precursor of tin has unique, radical properties that enhanced the chemical reactivity and greatly improved the metal oxide formation process. Both barium and tin are significantly cheaper than indium and are abundantly available."We were quite surprised at how well this unconventional approach worked the very first time we used the tin chemical precursor," said University of Minnesota chemical engineering and materials science graduate student Abhinav Prakash, the first author of the paper. "It was a big risk, but it was quite a big breakthrough for us."

Jalan and Prakash said this new process allowed them to create this material with unprecedented control over thickness, composition, and defect concentration and that this process should be highly suitable for a number of other material systems where the element is hard to oxidize. The new process is also reproducible and scalable. They further added that it was the structurally superior quality with improved defect concentration that allowed them to discover high conductivity in the material. They said the next step is to continue to reduce the defects at the atomic scale. "Even though this material has the highest conductivity within the same materials class, there is much room for improvement in addition, to the outstanding potential for discovering new physics if we decrease the defects. That's our next goal," Jalan said.

Story Source:

Materials provided by **University of Minnesota**. Note: Content may be edited for style and length.

Journal Reference:

1. Abhinav Prakash, Peng Xu, AlirezaFaghaninia, Sudhanshu Shukla, Joel W. Ager, Cynthia S. Lo, Bharat Jalan. **Wide bandgap BaSnO3 films with room temperature conductivity exceeding 104 S cm−1**. Nature Communications, 2017; 8: 15167 DOI:10.1038/ncomms15167

PEOPLE AREN'T THE ONLY BENEFICIARIES OF POWER PLANT CARBON STANDARDS

VISHWESH MOUNESHWAR MANVACHAR, SHINAGARE CHINMAYA R, NALAWADE SHANTANU SHRIKANT, CHUDMUNGE NIKHIL

When the Environmental Protection Agency finalized the Clean Power Plan in 2015 it exercised its authority to regulate carbon dioxide emissions to protect public welfare. The Plan, now the focus of escalating debate, also put the nation on course to meet its goals under the Paris Climate Agreement. Given that other pollutants are emitted from power plants along with carbon dioxide research has shown that carbon emission standards for the power sector benefit human health. New research released today shows that they would also benefit crops and trees.

The study, "Estimating Potential Productivity Co-Benefits for Crops and Trees from Reduced Ozone with U.S. Coal Power Plan Carbon Standards," was recently published in the Journal of Geophysical Research Atmospheres and authored by researchers from Drexel University, Syracuse University, Boston University, and Harvard University, convened by the Science Policy Exchange. It is the first study to model the ecosystem impact of contrasting policies, one of which was similar to the Clean Power Plan.

"In assessing the regulatory impact of the Clean Power Plan the EPA estimated monetary benefits of reduced carbon-dioxide emissions, as well as quantifying and monetizing certain public health benefits, such as reduction in premature mortality and morbidity due to particulate matter or ozone exposure," the researchers write. "The EPA did not quantify the co-benefits to crops and trees but treated these co-benefits qualitatively."

According to the study, which included an option similar to the Clean Power Plan, the corresponding reduction in carbon, nitrogen and sulfur emissions from coal power plants would also mean a decrease in ground-level ozone a known inhibitor of plant growth. And by modeling these reductions in the year 2020, the researchers found that they would provide a significant boost to the productivity of key indicator crops, such as corn, cotton, soybean and potato; as well as several tree species.

"Our findings suggest that crops like corn, soybeans and cotton could benefit from substantial productivity gains under moderate carbon standards for power plants," said Shannon Capps, PhD, an assistant professor in Drexel's College of Engineering and an author of the study. "With policies similar to those in the Clean Power Plan, we're projecting more than a 15 percent reduction in corn productivity losses due to ozone exposure, compared to business as usual, and about half of that for cotton and soybeans. Depending on market value fluctuations of these crops over the next few years, that could mean gains of tens of millions of dollars for farmers especially in areas like the Ohio River Valley where power plants currently contribute to ground-level ozone."

The team used three policy scenarios that encompass a range of emissions targets and reductions measures, and they compared each policy scenario with a "business-as-usual" reference case that represents current clean air policies, as well as energy demand and market projections.

Then, using a computer model widely employed to help guide state-level decision making for compliance with the National Ambient Air Quality Standards, the group generated a detailed projection of what the surface-layer ozone would look like across the country under each policy scenario through 2020.

The team looked at the consequences of lower ozone for five crops whose primary growing season is June through August, which is the period when ground-level ozone is known to be at its peak. They also evaluated the consequences for 11 tree species, including eastern cottonwood, black cherry, quaking aspen and several species of pine. These crops and trees have been used as standard indicators in environmental research. Based on previous research by crop and tree scientists, the team could relate their models' ozone-exposure findings to the productivity of crop and tree species.

"The option most similar to the Clean Power Plan has the greatest estimated productivity gains for the crops and trees that we studied," said Capps. "The improvement in crop yield and tree growth was strongly tied to the level of carbon dioxide emissions reductions and adoption of cleaner energy achieved by the policy."

Under the business-as-usual scenario, the productivity of soybean, potatoes, and cotton is reduced about 1.5 percent, with only slight impacts on corn. These levels of production only slightly improve under a policy scenario that includes only "inside the fenceline measures" such as improving the efficiency of coal-fired power plants. A second scenario, that most closely resembles the Clean Power Plan and includes demand-side energy efficiency, substituting lower-emitting natural gas plants and zero-emitting solar and wind power into the energy mix produces larger results. The potential corn production lost to ozone exposure in the reference scenario is reduced by 15.7 percent, soybean losses are reduced by 8.4 percent and cotton losses are diminished by 6.7 percent.

Under the third scenario, which reflects putting a price on carbon, and achieves similar emissions reductions as the second scenario, the researcher's project slightly lower reductions in ozone-induced losses for corn (12.1 percent), soybean (6.6 percent) and cotton (3.8 percent)?

Productivity among tree species, as measured in biomass yield compared to the reference scenario, also suggests that the plants will benefit from ozone-reducing policies. The tree species with the greatest potential for productivity losses, black cherry and eastern cottonwood, show 7.6 and 8.4 percent reductions in the projected ozone-induced biomass reductions, respectively, under the scenario most like the Clean Power Plan.

"Our work shows the importance of considering the co-benefits of our nation's energy policies going forward," said Charles Driscoll, PhD, professor at Syracuse University and co-author of the study. "These benefits to people and plants are nearly immediate and occur in urban and rural communities across the U.S. We know from this and other studies that the economic value of the added benefits from power plant carbon standards are large and exceed the estimated cost of implementation."

Members of the team are also analyzing the co-benefits of power plant carbon standards for reducing regional haze and acid rain and conducting new research on the co-benefits of the final clean power plan as compared to different energy policy futures.

Story Source:

Materials provided by **Drexel University**. Note: Content may be edited for style and length.

Journal Reference:

1. Shannon L. Capps, Charles T. Driscoll, HabibollahFakhraei, Pamela H. Templer, Kenneth J. Craig, Jana B. Milford, Kathleen F. Lambert. **Estimating potential productivity cobenefits for crops and trees from reduced ozone with U.S. coal power plant carbon standards**. Journal of Geophysical Research: Atmospheres, 2016; DOI:10.1002/2016JD025141

THEORY OF SOLAR DRYING

ADAMAPURE AMRUTA SATAPPA, GEJAGE AMOL ASHOK, HATPAKI PRASAD RAJENDRA, JADHAV VILAS KUMAR, DIYA SANADI, ABHISHEK CHOUGULE

Several process technologies have been employed on an industrial scale to preserve food products; the major ones are canning, freezing, and dehydration. Farmers dry food products by natural sun drying, an advantage being that solar energy is available free of cost, but there are several disadvantages which are responsible for degradation and poor quality of the end product. Certain variety of food products are not supposed to be dried by natural sun drying because they lose certain basic desirable characteristics. Experiments carried out in various countries have clearly shown that solar dryers can be effectively used for drying agricultural produce. It is a question of adopting it and designing the right type of solar dryer. Among these, drying is especially suited for developing countries with poorly established low temperature and thermal processing facilities. It offers a highly effective and practical means of preservation to reduce post- harvest losses and offset the shortages in supply. Drying is a simple process of moisture removal from a product in order to reach the desired moisture content and is an energy intensive operation. The prime objective of drying apart from extended storage life can also be quality enhancement, ease of handling, further processing and sanitation and is probably the oldest method of food preservation practiced by humankind. Drying involves the application of heat to vaporize moisture and some means of removing water vapor after its separation from the food products. It is thus a combined and simultaneous heat and mass transfer operation for which energy must be supplied. The removal of moisture prevents the growth and reproduction of microorganisms like bacteria, yeasts and molds causing decay and minimizes many of the moisture-mediated deteriorative reactions. It brings about substantial reduction in weight and volume, minimizing packing, storage, and transportation costs and enables storability of the product under ambient temperatures. These features are especially important for developing countries, in military feeding and space food formulations.

At the same time continuous increasing pressure of energy demand, the degradation of environment through greenhouse gas emissions and the rise in fuel prices are the main driving forces behind the efforts for more effectively utilizing various sources of renewable energy. Renewable technologies are considered as clean energy sources and optimal use of these resources minimizes environmental impacts and produces minimum secondary wastes, and such resources are sustainable based on current and future economic and social societal needs. Energy in various forms has been playing an increasingly important role in worldwide economic progress and industrialization. The growth of world population coupled with rising material needs has escalated the rate of energy usage. Rapid increase in energy usage characteristic of the past 50–100 years cannot continue indefinitely as finite energy resources of earth are exhaustible. Therefore, there is a need to explore the renewable energy sources to meet out the energy demand in present context. Renewable sources of energy have emerged as a crucial option, on account of the greater energy demand, price volatility of fossil fuels, climate mitigation and energy crisis due to the increasing depletion of fossil fuels. However, the unpredictability of the output of renewable energy conversion systems demands robust, reliable and efficient technologies. Such systems can produce savings by reducing the energy use and displacing fossil fuel expenditures. The United Nations general assembly in December 2010 designated 2012 as the international year of sustainable energy for all, aimed at ensuring universal access to modern energy services, doubling the rate of improvement in energy efficiency, and doubling the share of renewable energy in the global energy mix by 2030, thereby achieving economic and environmental goals. Accelerated renewable energy development can contribute significantly to a country's energy security, besides creating new jobs in rural areas and facilitating rural development. The renewable energy share of global energy consumption in 2010 are shown in Fig.1

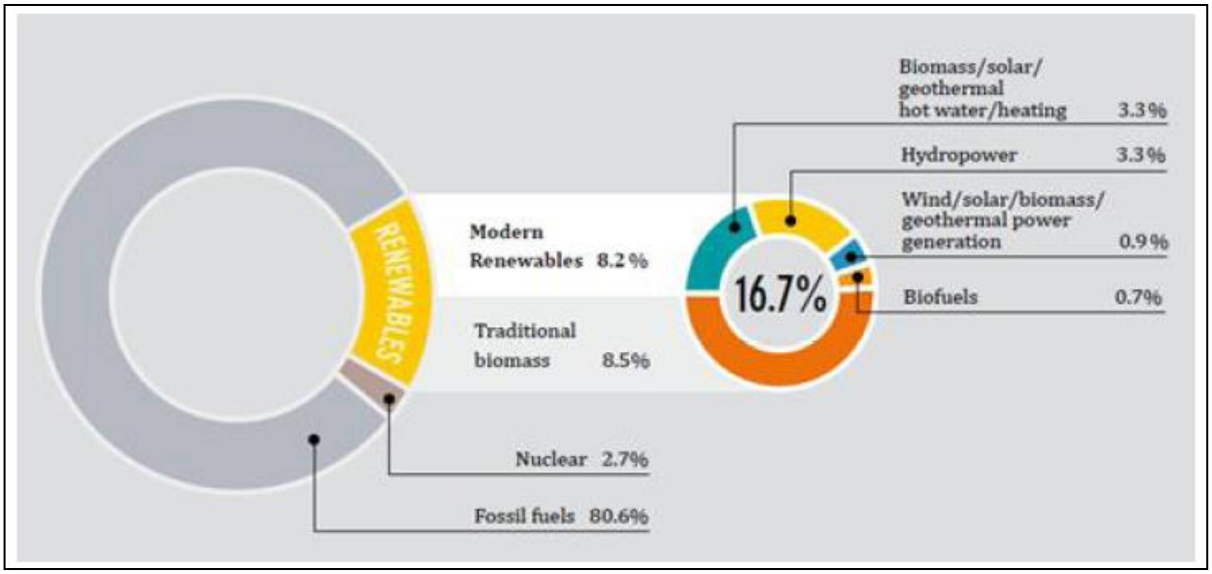


Fig.1. Renewable energy share of global energy consumption Source: REN 21 global status report in 2013

Solar energy is the one most abundant renewable energy source and emits energy at a rate of 3.8×10^{23} kW, of which, approximately 1.8×10^{14} kW is intercepted by the earth. The primary forms of solar energy are heat and light. Sunlight and heat are transformed and absorbed by the environment in a multitude of ways.Solar thermal energy is the cheapest and widely available renewable energy that often replaces fossil-fueled or electrical water heating, reducing utility bills and greenhouse gas emissions. All the developed nations are in the process of promoting the use of solar energy for various applications. India is endowed with a high solar energy potential. India is actively pursuing the development of renewable energy technologies, especially solar based technologies, as high solar radiation is present in major regions, with a majority of days of clear sun.

REFERENCES

1. El-Sebaii AA, Abdul-Enein A, Ramdan MRI, El-Gohary HG. Experimental investigation of an indirect type natural convection solar dryer. Energy Conversion and Management 2002; 43:2251–66.
2. Pangavhane R Dilip, Sawhney RL, Sarsavadia PN. Design, development and performance testing of a new natural convection solar dryer. Energy 2002; 27(6):579–90.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