raising towards the surface undergo evaporation, including increasing salinity and CO_2 degassing, and finally leading to breakdown of the uranyl carbonates.

The Saraswati palaeochannel has been traced by earlier researchers across the entire Thar Desert and the present occurrence of Mg-rich uraniferous calcrete at Khemasar brings out the importance of the palaeochannel as a future exploration target for surficial uranium concentrations.

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ACKNOWLEDGEMENTS. We thank the Director, AMD and Additional Director (Op. I), AMD for granting permission to publish this article. We also thank the officers and staff of Chemical Laboratory, AMD, WR, Jaipur, for providing chemical analysis of the samples.

Received 1 March 2014; re-revised accepted 24 February 2015

Ant larvae silk fibres mat

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Weaver ants (*Oecophylla smaragdina*) are mostly seen in open forests of India, Australia, China and South-east Asia. The nests of weaver ants are built with silk secreted by their larvae. Silk fibre mat is a biopolymer, containing proteins produced by a broad array of spiders and other insects. In this study some hidden properties of weaver ant silk mat have been examined. The surface and structural studies reveal that the mat possesses very good chemical resistance.

Keywords: FT-IR, scanning electron microscope, silk fibre, weaver ant.

ANTS are the most commonly seen insects in our surroundings. Identifying ants is an easy task because they will have three pairs of legs, antennae and their disciplined march is enough to recognize them. They are highly social creatures and also referred to as 'super organisms'. In our society, ants are considered as a symbol of hard work and disciplined life. A typical ant colony

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consists of the queen and several classes of worker sister ants. Ant colony is a female dominant one and male ants have a lesser role to play in the development of a colony. Queen ant is physically larger than worker ants and possesses symbolic wings. Queen ant does not order the worker ants. It appears that efficient teamwork is coded in their genetic material. Queen ant also provides a unique odour to all colony workers, which serves as their identity card. There are more than 15,000 species[1] of ants all over the world. Each type of ant species has a unique characteristic behaviour. Harvester ants collect the seeds which are used as food. A special ant species found in Africa known as leaf cutter ant cuts leaves from trees which are used as a source to grow fresh fungus; later this fungus serves as a feed for the ants. The fire ants (fire ants are different from fungus growing ants) form a lifeboat by joining one another; the hydrophobic surface of the fire ants prevents them from getting wet and the surface tension of water is used effectively for survival. These are some example of incredible ants in nature. In India, there are 652 species of ants[2]. The most commonly seen species of ants are harvester ants, army ants and weaver ants[3]. A weaver ant (*Oecophylla)* is a special one and shows some incredible architectural skills in nest construction. As the name itself indicates, these ants weave their nest by joining leaves of a tree and exhibit marvellous teamwork for their survival. These weaver ants are found in Southeast Asian countries such as India, Australia, Malaysia and some parts of Africa.

In the current scenario, the study on ants has become a dominant area of research. They are helping us solve real-life problems in fields such as controlling traffic, computer networking and even space science.

Weaver ants are the oldest-known for the biological control of insects in the history of agriculture. These ants protect trees from pests and other foreign insects by consuming them. Interestingly, these ants also enter into a symbiotic relationship with other insects such as caterpillars. Caterpillars produce honeydew from their dorsal gland, which is rich in sugar and consumed by ants. Thus, the caterpillars get ants as bodyguards to protect from their natural predators. These ants also play a prominent role in the food chain and helps in maintaining ecological balance. Throughout Southeast Asia, weaver ants are a significant commercial product. In Thailand, large queen larvae and pupae are harvested as a food product for human consumption, and in India, it is used in pharmaceuticals. They are also used as pet food and fishing bait. There is a well-developed market for ant brood (larvae and pupae) in Indonesia. The brood is collected by rural people from natural habitats to earn money or for regular full-time income. Demand for the brood is increasing day by day due to its high nutritious value, hence weaver ant farming is highly profitable[4].

It is easy to identify a weaver ant colony on a mango tree. One can see the huge lump of leaves on top of the tree or can notice that some leaves of the tree are joining together and red ants are just wandering on them. The weaver ant nest is most complex in nature. They exhibit marvellous skill, technique and dedicated teamwork in nest construction. Chains of worker ants between young leaves of the tree, help to create a well-structured nest. During the formation of nest, two leaves are pulled together by several worker ants and keep them in the proper position. Another group of worker ants reduces the distance between them. When the distance between two leaves is shortened sufficiently, the young larvae from the queen's chamber will be shifted to the nest, by the worker ant. The larva is gently squeezed with mandibles. The squeezing of larvae produces fine silk fibre which is used as glue to join the leaves. The worker ant holding the larva moves its mandibles from the edge of one leaf to another. This to and fro motion between leaves is repeated until the leaves are stick firmly. This process appears as if the ants are weaving their nest. Hence, these ants are named as 'weaver ants'. The collection of fibres appears as a mat-like structure between leaves. Later, a chain of ants are released and construction of nest continues by joining the nearby leaves. Weaver ant nest spreads all over the tree as shown in Figure 1. The queen is located in one of the nests and larvae are delivered to newly constructed nests. The worker ants were continuously building new nests (Figure 1 *b*), because there is a great risk of nest damage through high wind and ageing of leaves. The nest constructed by the weaver ant larvae is used as a weaver ant mat.

Natural fibres are commonly made up of cellulose, proteins, lipids, etc. Natural fibres are nothing but biopolymers. A repeated chain of monomers (nucleotide, peptide and saccharides) is linked to form a structure. Silk produced by the weaver ant larvae is another example of a biopolymer. These protein-based biopolymers are porous, flexible, eco-friendly, light weight, exhibit marvelous mechanical and chemical properties and disease-resistant properties. Naturally obtained polymers are biodegradable with high biocompatibility and minimal inflammatory. This biopolymer is hydrophilic when freshly woven between leaves and later it becomes hydrophobic. Due to these amazing properties, biopolymers are opening up unimaginable applications in different fields of science. Mulberry silk fibre and spider silk fibre are extensively studied all around the world, whereas the study of silk produced by weaver ants larvae are less exploited so far. There are many mysteries to be unfolded to understand the role of these fibres in weaver ant colonies.

Due to these amazing properties, weaver ant silk fibre mats are attracting researchers from various backgrounds. These woven fibres are in mesh form and finding potential applications in nanotechnology. Fibres produced by these larvae are in micro or nanoscale and possess uniform structure. Even highly electro spun fibres fail to attain the uniformity of these fibres.

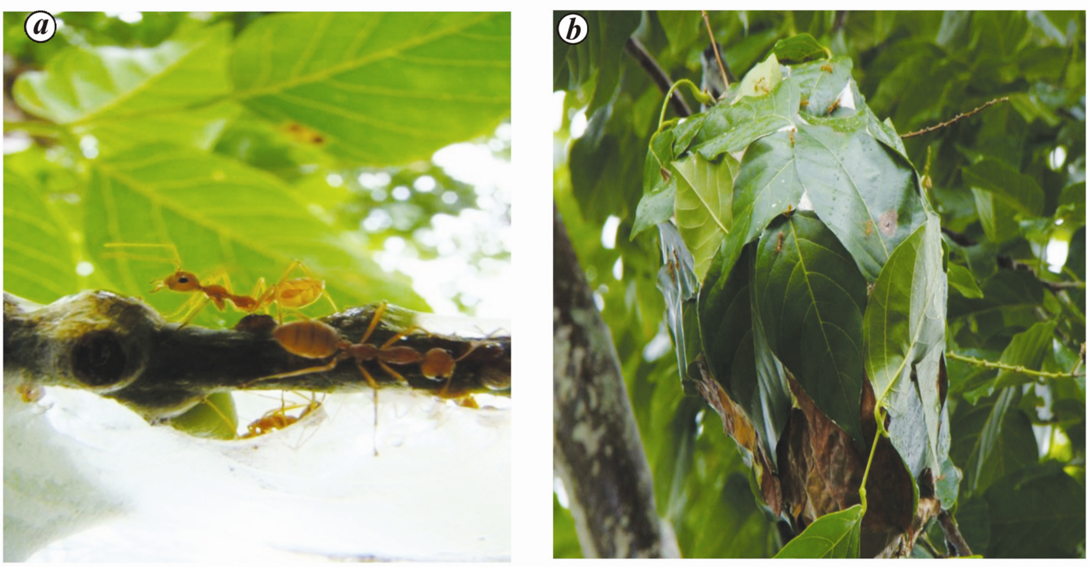

Figure 1. ***a***, Weaver ant; ***b***, Weaver ant nest (Photo by M. Prajwal).

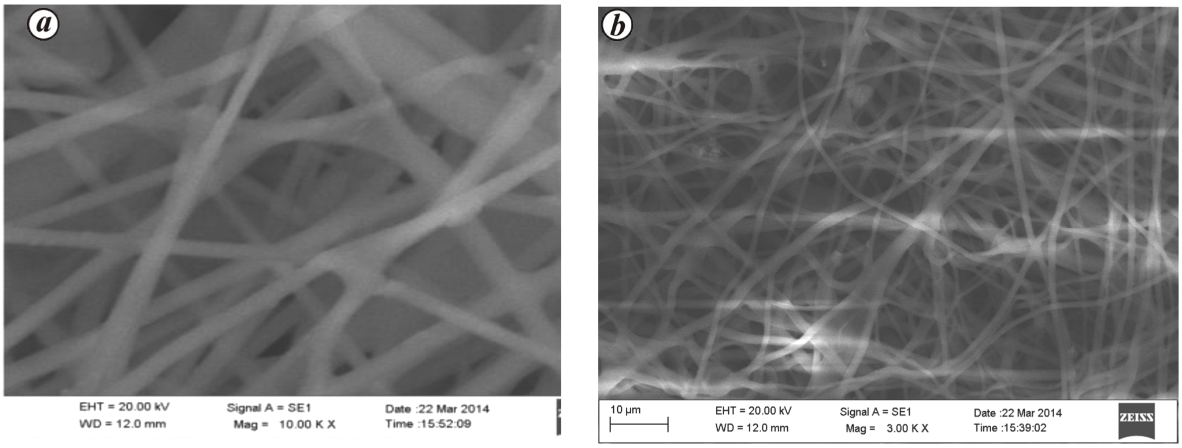

Figure 2. ***a***, Surface morphology of weaver ant silk mat before chemical treatment; ***b***, After chemical treatment.

In the nanoworld, the behaviour of materials is entirely different from the macroworld. Nanomaterials exhibit high surface to volume ratio which enhances various properties of the material. Nanofibres can also be produced in the laboratory by electro spinning technique. The process is similar to that of cotton candy making machine. Fibres in nanorange with uniform structure are in high demand. As technology advances and gadgets are becoming slim and lightweight, health sector needs advanced technology to combat deadly pathogens. Nanofibres with ecofriendly properties are an ideal solution for modern problems and find their way into unimaginable applications in different fields of research as follows.

1. Tissue culture: Biodegradable polymer fibre mats are extensively used in tissue culture research. A highly porous fibre mat was used as base support in growth media to grow the desired cells[5].

2. Drug loading: Biodegradable polymers are used in targeted drug delivery systems. These polymers are shown to increase drug sorption. Later, these fibres are allowed to release the drug in the targeted organ. In treatment of brain tumour, these biodegradable polymers are used to load chemotherapeutic agents and are implanted into the brains of rats, rabbits and monkeys. The results show that the polymer is biocompatible and is found effective in therapy[6]. It is found that weaver ant silk fibre mats are good drug loaders compared to other naturally obtained fibres (from spider and mulberry silkworms)[7].

3. Biosensors: Emerging nanotechnology allows us to design unique methods to detect the pathogens inside our body. Nanowires, nanoparticles and nanotubes are becoming a popular medium to design such systems. Biodegradable electrical conducting and magnetic

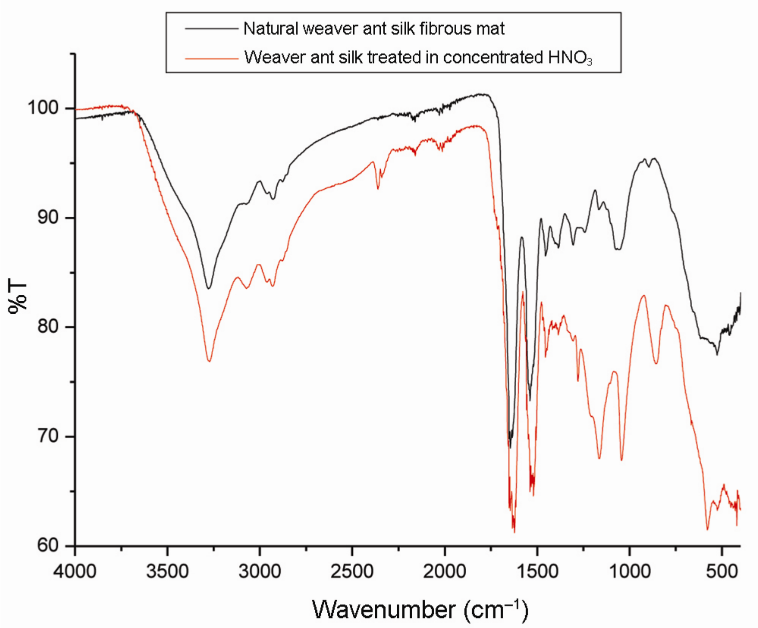

Figure 3. FT-IR graph of weaver ant silk mat before and after chemical treatment.

nanoparticle-coated polymers are in high demand in the field of biosensors[8].

4. Biodegradable solar cells: These types of solar cells were likely to be developed in the future. The existing solar cells can cause environmental pollution. To overcome this problem, biodegradable solar cells are an ideal solution. The research is underway to develop durable solar cells efficiently[9].

5. Artificial nerve tube: Biocompatible nanofibres coated with highly conducting nanoparticle could be used as an artificial nerve tube. As the technology advances robotic arms or limbs require a highly sensitive conductor which is able to receive and send impulses to the brain.

From our experimental studies, it was found that the weaver ant silk fibre mat is highly resistant to various chemical treatments. Surface analysis of the woven silk fibre using scanning electron microscope (SEM) (Figure 2 *a*) has been performed. A chemically treated weaver ant silk fibre mat is shown in Figure 2 *b*. Structural analysis is carried out for the same fibre mat using FT-IR and a graph is obtained (Figure 3). Structural and surface analysis reveal that there are no changes even after the chemical treatments. Hence, the weaver ant silk mat possesses chemical resistivity. In its natural state, the weaver ant silk fibre mat is an excellent insulator. By coating the conducting polymers or adsorption of conducting nanoparticle, the ant silk fibre mat becomes a sensitive conductor. This ant silk fibre mat displays friendly interaction with nano conducting polymers. The study of weaver ant silk fibre mat for various applications has great scope for research. Nature is a great teacher since we always mimic things and bring them out in the form of new technologies for societal use. These technologies will be beneficial for the community in direct or indirect ways. A scientific discovery has no limit. New innovations are required for development. Inventing a novel method of producing weaver ant larvae silk artificially would be a great achievement.

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Received 2 January 2015; revised accepted 12 February 2015