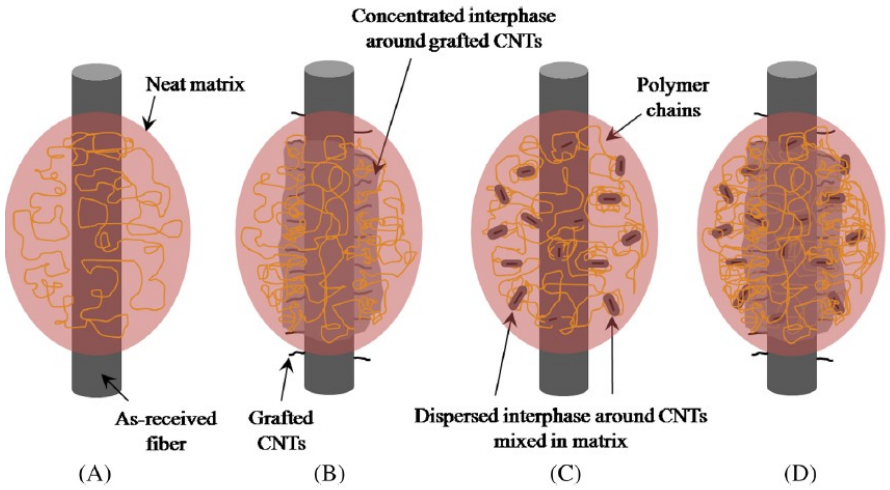
Research highlights: Mechanics of Advanced Materials Laboratory (MAdMatLab)

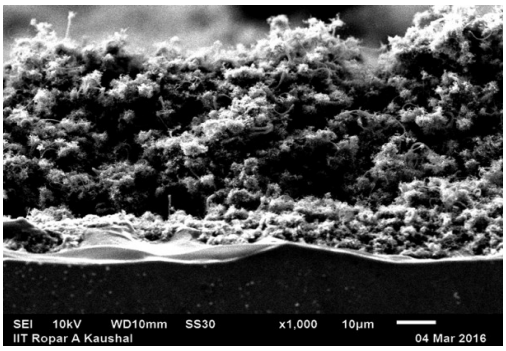
1. Interface designing in composites:

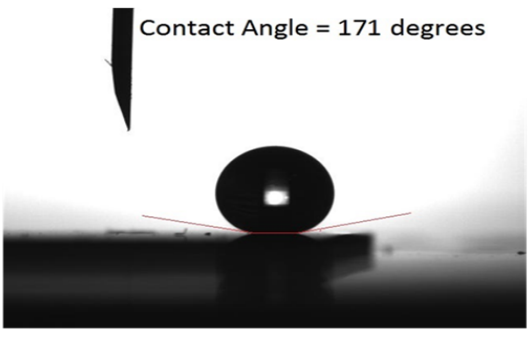
Interface is most critical yet least understood region in fiber reinforced plastics. For the first time, we have experimentally quantified the size and stiffness of interphase in CNT grafted carbon fiber/epoxy multiscale composites. It is also shown that interfacial strength is not a constant material parameter but depends on the microstructure and loading rate. Later on, interphase engineering is used as a design tool to tailor the average mechanical and fracture properties of carbon fiber/epoxy composites. (***Carbon, Engineering Fracture Mechanics, Polymer Composites, RSC Soft Matter, Journal of Applied Polymer Science, Fracture and Structural Integrity***). **Our publication adjudged most downloaded and top 20 read article in polymer composites for two years consecutively in 2017-2018 and 2018-2019**.

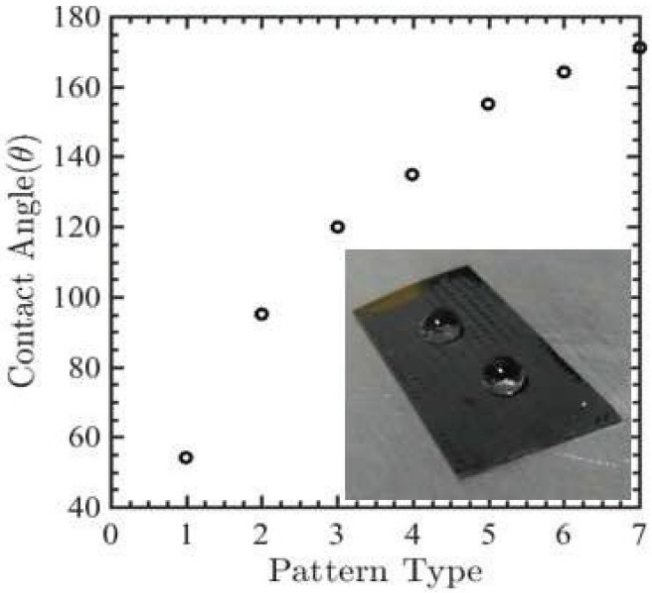


2. Superhydrophobic surfaces:

Fabrication of lotus like artificial surfaces is desirable in many technologically important areas such as Aircraft, Naval, wind turbines, MEMS etc. We have created lotus like hierarchal superhydrophobic surfaces using patterned growth of carbon nanotubes. The hydrophobicity of these surfaces can be controlled. A patent has been filed based on the outcome of this work. In an extension of this work, we are trying to understand the wettability of nanocolloids and their impact behaviour on superhydrophobic surfaces in collabartion with Prof S K Das and Purbarun Dhar from Mechanical Engineering Department. (***Physics of Fluids, Jornal of Phy Chem B., Euro Physics Journal E***). An **Indian Patent No. 349338** was issued on **15-Oct-2020** based on this work.

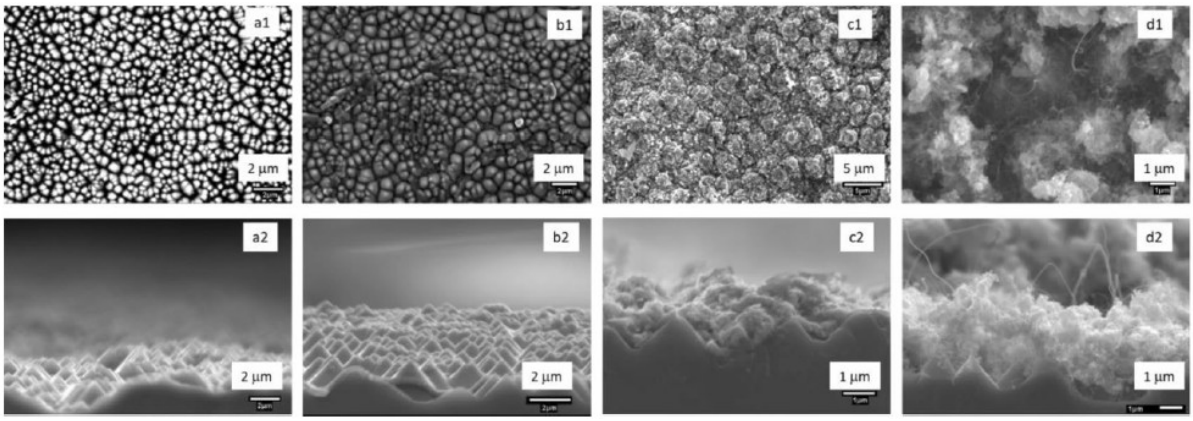


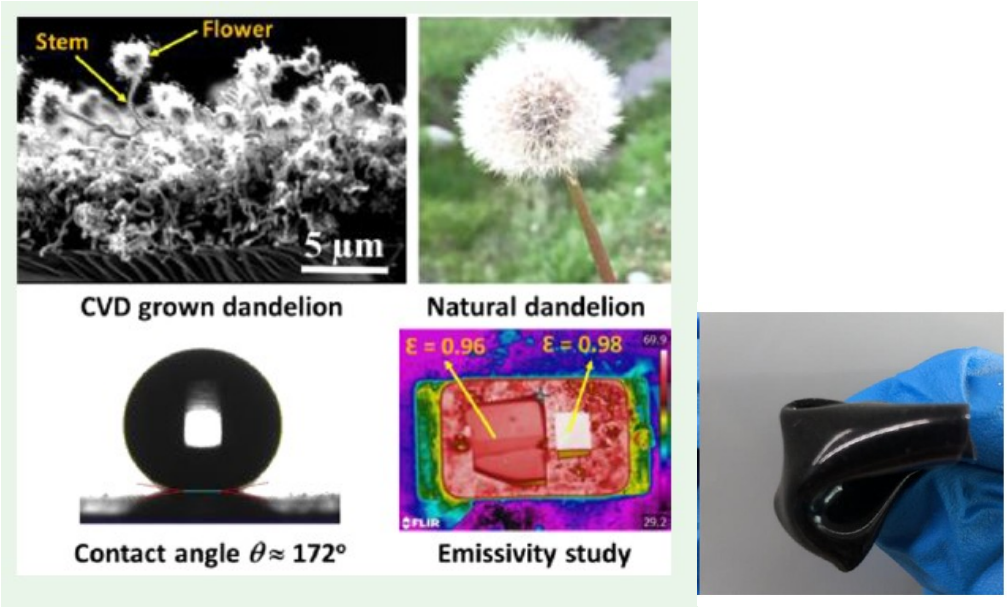




3. Near perfect black surface and broadband absorbers:

In this research work, design and fabrication of rigid and flexible broadband absorbers is realized using novel materials design concept. The developed absorbers show near perfect absorbing capacity (> 99.5%) in whole UV-Vis-NIR range at varying beam incident angles (10-60 deg). In addition, the superhydrophobic, self-cleaning behaviour of the processed layer makes it suitable for many technologically important areas such as stealth and solar PV applications. (*Scientific Reports, Advanced Materials Technologies, Vacuum and Journal of Applied Polymer Science*). **1 Indian patent no 201911002233** is **published on 24/07/2020** based on this work. As an extension of the efforts made in this work, *one of the darkest man made material* is created by introducing hierarchical features in carbon nanotubes which are given the name flower carbon nanotubes (FCNTs) as they look like dandelion flowers (*ACS applied nanomaterials*). These FCNTs have emissivity 0.98 and show broad band absorption of close to 100%.

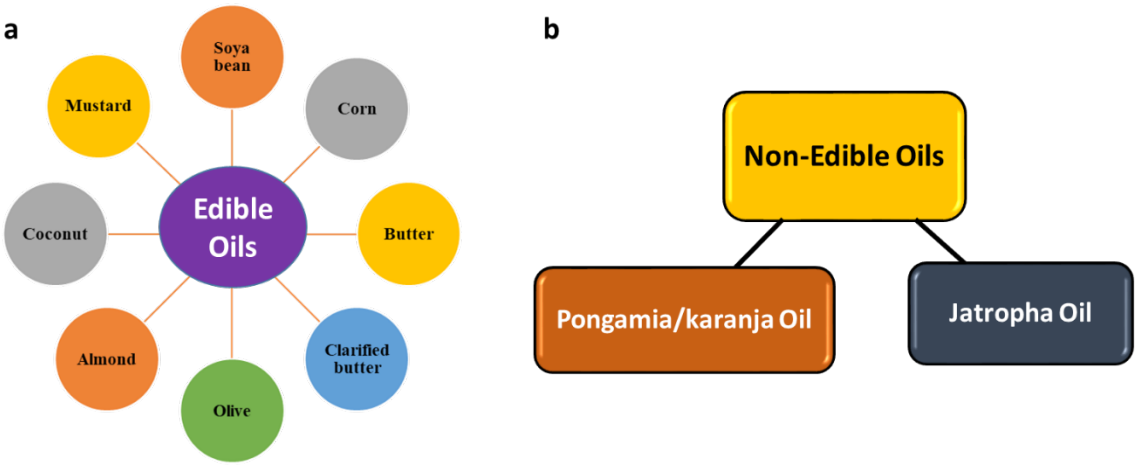


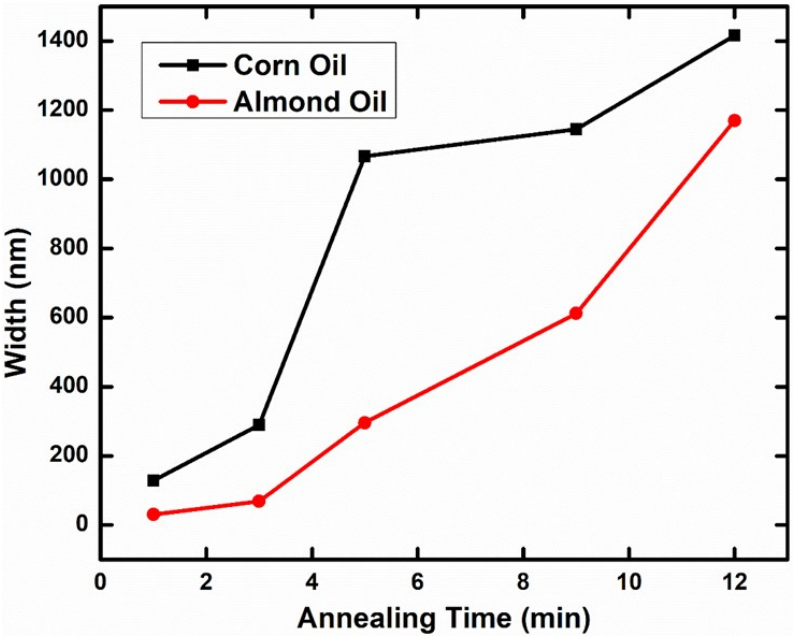


4. Waste-to-wealth technology:

In this work, following two key technologies are developed,

a. Synthesis of vertically aligned graphene sheets on different substrates using edible (Soybean, Almond, Mustard, Coconut, Corn, Olive, Clarified butter, Butter) and non-edible (Jatropha, pongamia/karanja) oils. An Indian patent (Patent Application No.: 202011014217, Filing date: 31/03/2020) has been filed based on this work.





b. Synthesis of Carbon Quantum Dots, Activated Carbon, Graphene Oxide and Reduced Graphene Oxide from Walnut Shell waste. This technology is a significant step towards creating wealth from waste in J&K region as wall nut shells are readily available in huge amount there. These shell are generally thrown and we have developed processes to create useful nanomaterials from this waste. An Indian patent (Patent Application No.: 202011040071, Filing date: 16/09/2020) has been filed based on this work.