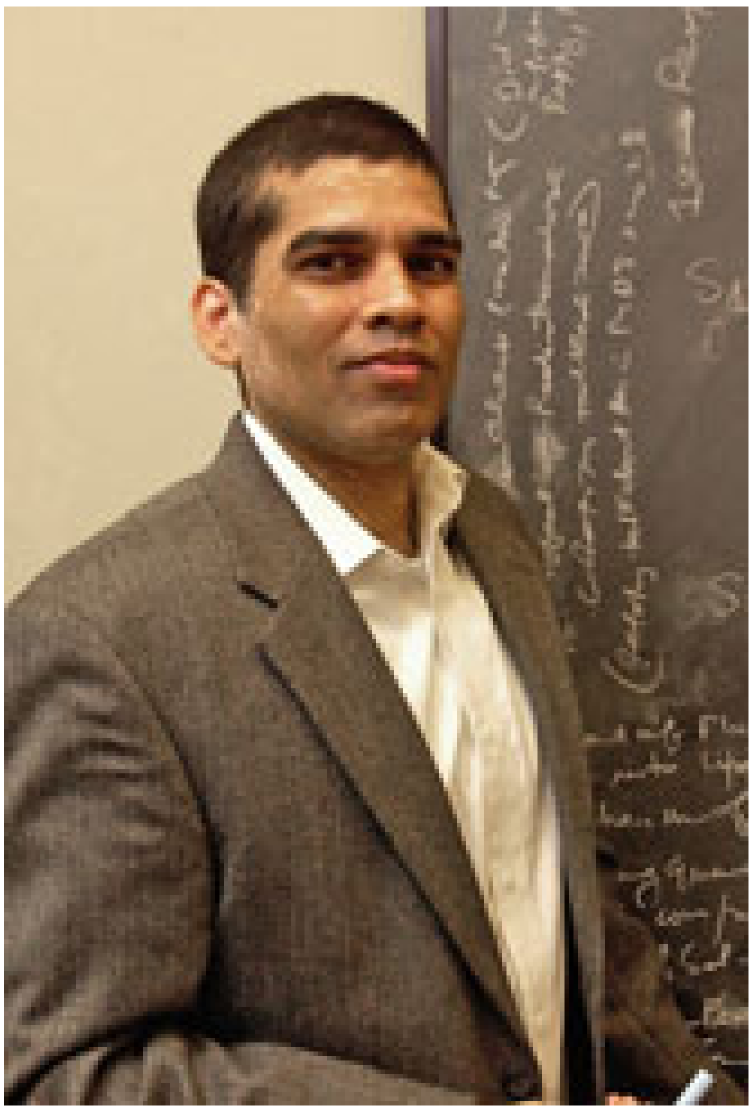
2021 Distinguished Alumni Lectureship



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Spontaneous three-dimensional nanoporous microscale ribbons induced by anisotropic thermal oxidation

Spontaneous large scale three-dimensional organic-inorganic hybrid microscale ribbons were fabricated via anisotropic oxidation of silicone films. This resulted in micro-ribbons with an aspect ratio as high as 103, possessing a spiral shape with a surface area comparable to that of single wall carbon nanotubes. The FTIR, NMR, and XPS characterizations revealed that the polymer film underwent significant oxidation. Dynamic mechanical analysis (DMA) and nanoindentation measurements on micro-ribbons indicated generation of Young's modulus gradient along the micro-ribbon thickness due to anisotropic oxidation of the polymer film. The mechanism of formation of the micro-ribbon was investigated using high-speed optical imaging which showed that the delamination speed was on the order of many kilometers per second. Interestingly, a pseudo-phase diagram involving the thickness of the film, temperature, and curing time indicated that the formation of the micro-ribbon occurs within a small "sweet spot volume". As it turns out, the functionalization of micro-ribbons is a straight-forward process. Fluorescent, magnetic, electrically conductive, and nanoscale patterned micro-ribbons were fabricated in a one-single step. The entanglement of micro-ribbons at the oil-water interface allowed break-up of oil-water emulsion in less than few seconds yielding partition and separation of the oil-water mixture for oil recovery. Furthermore, the functionalized PDMS micro-ribbons were mechanically assembled into complex 3D structures with potential applications in the fabrication of functional devices for microelectronics, biomedical, and bioengineering fields.

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Zoom ID: 983 5394 6886

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