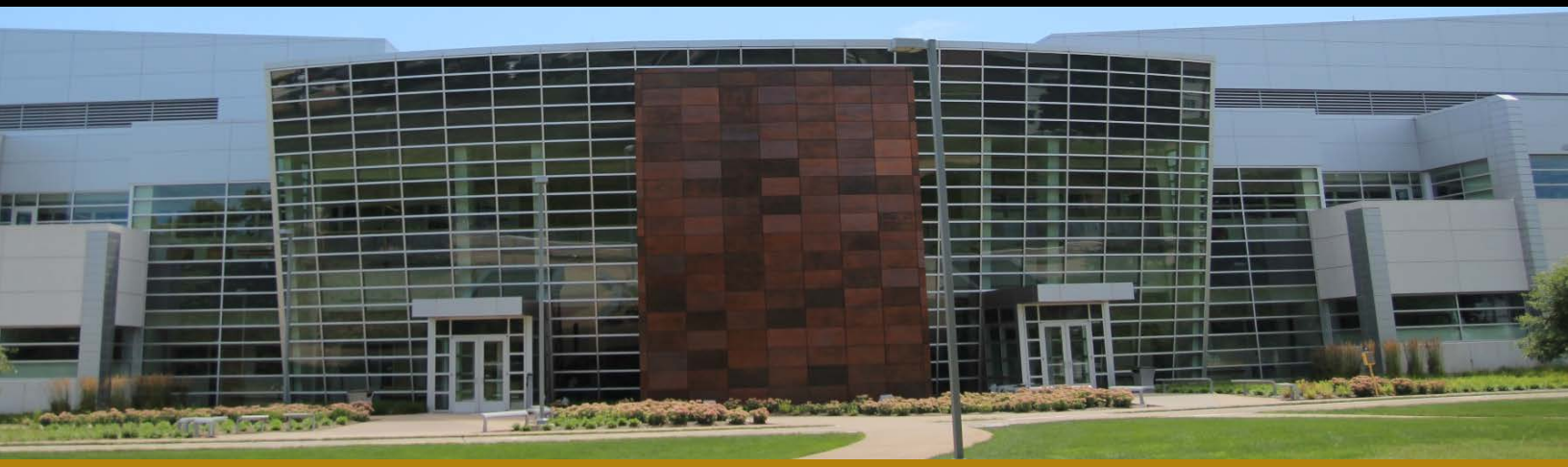
PURDUE UNIVERSITY



Birck Nanotechnology Center

Nanomanufacturing Preeminent Team Faculty Seminar

Dr. Bryan Vogt

Processing science at scale to traverse the 'valley of death' from fundamental science to commercialization

Monday, February 26th, 2018
9:30am – 10:30am , BRK 1001

Abstract: Translation of innovation from fundamental research to commercial product is commonly hindered by the costs associated with scale-up and development of manufacturable processing routes. An integrated approach where concepts of scale-up, efficient processing, and cost are considered from the beginning of the research project will be described in the context of vignettes, described below, where manufacturable solutions to defined commercialization problems are being developed.

One challenge associated with emergent virtual reality (VR) platforms is motion sickness side-effects. The immersive experience of VR provides the sensation of motions through sight but fails to stimulate the vestibular network. This conflict in stimuli for the brain can lead to motion sickness and provides a challenge in mass adaptation of VR. Stimulation of the vestibular network requires electrical connections through the skin. Penetration of the stratum corneum by an external electrode is one solution, but would be subject to FDA scrutiny, increasing costs as well as creating risk of transference of disease from the sharing of VR devices. A recent dry electrode design based on a textured surface can compress the stratum corneum sufficiently to provide external electrical connection with the vestibular network through electrodes on the forehead, behind the ears, and back of the neck. However, user comfort is poor with this technology due to the rigid electrode, so when the user moves the skin is locally pinned by this electrode, causing discomfort. To overcome this challenge, a manufacturable roll-to-roll process is discussed. This process generates textured surfaces using magnetic fields that create rigid conductive channels protruding from the surface surrounded by an elastomer with mechanical properties similar to skin. This formulation is based on commercially available materials that have been developed independently: poly(dimethylsiloxane) as the elastic component and Ni@Ag particles (developed for EMF shielding paints) that are aligned by the magnetic field into columns to generate the more rigid and electrically conductive component. Production of the desired structures and conductivity can be readily controlled through process variables with the potential for on-the-fly modulation of the surface topology to enable extension to other applications.

Similarly, fundamental early-stage research can also benefit from consideration of scalability, processing and manufacturability. Shorter vignettes will be presented describing how these concepts can be applied generally to defined problems at various technical readiness levels (TRLs). At higher TRL, there remain challenges with obtaining excellent mechanical properties from 3D printing for plastic parts, which we overcome through a materials-centric approach that uses combinations of commodity plastics. Finally, we discuss how roll-to-roll processing is being used to fabricate low cost self-assembled materials for beyond Li ion battery technologies.

PURDUE UNIVERSITY Discovery Park