UH ENGINEER SEEKS TO LEARN MORE ABOUT CRYSTAL FORMATION

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NSF-Funded Work Holds Promise for Health Care, Energy, Other Fields

Crystal formation is key to fields as disparate as drug design, biomedical diagnostics and petrochemical production, but significant questions remain about how that formation begins in the presence of soft materials. A chemical engineer from the University of Houston has received a $500,000 CAREER award from the National Science Foundation to increase understanding of crystal nucleation within polymers and other soft materials. Jeremy Palmer, assistant professor of chemical and biomolecular engineering, uses computational methods to study the early stages of crystal formation, before the process can be viewed experimentally.

The formation can take time, and small crystalline clusters that form within liquids don’t always grow into full-fledged crystals. Experiments show, however, that the presence of other materials such as polymers and proteins can change the likelihood of crystallization occurring.

“We don’t fully understand how the presence of soft materials influences crystallization,” Palmer said. A better understanding and the ability to control the crystallization process could prove helpful in all sorts of areas, including biological systems, pharmaceutical formulations, water and wastewater treatment plants, he said.

Most soft materials, the category covers a range of possibilities, from biological tissues to polymers, inhibit nucleation; Palmer’s work will rely on a polymer matrix to learn more at the molecular level about how the materials inhibit or promote crystallization.
If you understand the process, you could design a polymer matrix to help precipitate a compound, a key to drug development, he said. In other cases, such as in processing biological tissues, stopping crystallization is important to avoid damaging the sample.

NSF CAREER awards are granted to highly promising junior faculty members who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research. In addition to their research component, they also require educational outreach.

Palmer has proposed to continue his current outreach to students in kindergarten through high school, as well as to devise new outreach projects. He also will create a short course for graduate and undergraduate researchers addressing one of the hottest issues in science—whether findings by one research group can be reproduced by another. The class will cover proper documentation and other steps to encourage reproducibility.

It’s a huge issue, he said. Eighty percent of the work out there is not reproduced to the extent it should be. That may be due to a relatively simple error—forgetting to include a step in the process, or making a typo in computer code—but it is key to significant research.

If it can’t be reproduced, it’s not science, Palmer said.