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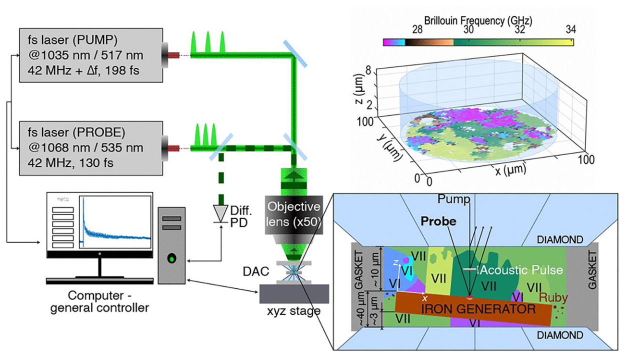
Textural changes, boundaries and interfaces can be characterized at extreme conditions with modifications to the light scattering technique.



Existing experimental techniques often face limitations in the visualization of textures in polycrystalline samples, which prevents the study of evolution at grain interfaces and boundaries. Sandeep et al. developed a modified time-domain Brillouin scattering (TDBS) method, which follows the propagation of acoustic pulses to characterize inhomogeneities in a material, with the ability to performing 3D imaging of polycrystalline textures at extreme conditions with micrometric resolution.

Using the technique on water ice, the group distinguished differently oriented grains of two crystalline phases – ice VI, which crystallizes in a tetragonal symmetry, and ice VII, which has a cubic symmetry. Characteristic features in the TDBS signals provided clear signs of interfaces between their grains as well as evidence of their orientations.

To enable these observations, the authors made a number of modifications to traditional TDBS. Asynchronous optical sampling was introduced for faster signal acquisition, while the addition of transverse acoustic modes helped identify the orientation of the grains within a common frame of reference. Finally, an updated signal processing methodology led to the easier and faster detection of grain boundaries.

This approach can be extended to study other polycrystalline transparent samples. For example, it may be used to investigate phase transitions and chemical reactions, such as those affecting the plasticity of minerals deep underground.

“The same is valid for any mixtures of transparent compounds, for example, rocks of planets,” said author Andreas Zerr. “Because water ice is composing interiors of the giant planets and moons of the Solar System as well as of some exoplanets, its phase composition and texture controls convection of the planet interiors at depths and pressures where the phases coexist.”

Source: “3D characterization of individual grains of coexisting high-pressure H_2O ice phases by time-domain Brillouin scattering,” by Sathyan Sandeep, Théo Thréard, Elton De Lima Savi, Nikolay Chigarev, Alain Bulou, Vincent Tournat, Andreas Zerr, Vitalyi E. Gusev, and Samuel Raetz, *Journal of Applied Physics* (2021). The article can be accessed at https://doi.org/10.1063/5.0056814.