Thin Film Enabled, High Pressure Lab-on-A-Chip Technology for Mineral Physics Applications

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Thin films have many characteristics which make them ideal for mineral physics studies. Due to their tailorable target chemistry and deposition conditions, thin films offer improved control of sample composition, phase (or phase assemblage), microstructure, surface structure, sample uniformity, and sample reproducibility than is possible with natural samples. Thin films can also be patterned (through shadow mask deposition, lithography, etc.) to produce DAC-embedded micro-sized circuits (*1*) or samples with precise, complicated geometries. Despite these benefits, the use of thin films in the mineral physics community remains limited.

This presentation will review a new line of research at Michigan State aimed at combining thin film multilayer samples, *in situ* wafer curvature measurements (*2-4*), and on-board pressure sensing thin films (*5*) to produce an optically-accessible "high-pressure-lab-on-a-chip" (HP-LOC) platform that enables materials property and phase relation measurements under precisely measured and precisely controlled non-hydrostatic stress states, water fugacities, and oxygen fugacities. The previously-inaccessible, controlled-atmosphere, anisotropic stress states possible with the HP-LOC platform will enable a variety of novel experiments such as 1) the *in situ* monitoring of serpentinization reactions, 2) mineral and phase assemblage stability studies under extreme levels of deviatoric stress (such as those occurring at plate boundaries), and 3) the study of high pressure solid-liquid, solid-solid, and solid-gas geochemical partition, diffusion, and chemical reaction rate coefficients. In addition, the HP-LOC platform also provides a means by which to incorporate high-pressure phases into everyday devices.

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