

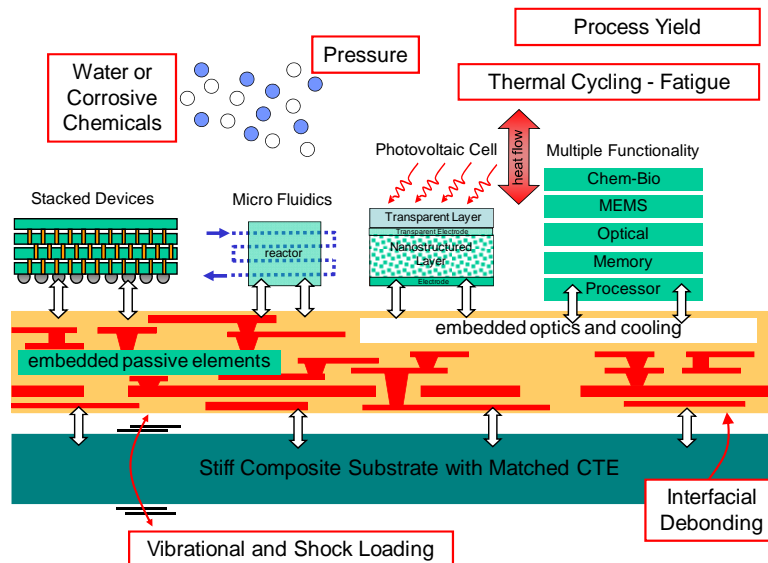
# Thermomechanical Reliability of Thin Films for Nano and Energy Technologies

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Materials and interfaces in device structures for emerging nano and energy technologies operate near the envelope of their mechanical and adhesive properties with remarkably high levels of film stress (**Fig. 1**). Debonding and cohesive fracture are major challenges for device reliability at all levels of processing, packaging and in-service.

## Thermomechanical Reliability of Complex Device Structures



**Figure 1:** Schematic showing complexity of device technologies and operating environments.

Our research enables innovation and design of high-performance nanostructured films by exploiting the fundamental connection between material structure and resulting function over a range of sub-micron length-scales. Underlying themes involve the manipulation of chemical and molecular structure of novel hybrid materials to achieve optimized properties, including thermomechanical function, adhesive and cohesive properties, and degradation processes under complex loading and severe environmental conditions.

In this lecture nanomaterials design and integration for thin-film structures in nanoscience and energy technologies will be reviewed. Unique challenges for such emerging technologies involve the effects of interfacial chemistry on adhesion, the introduction of new materials, process variables including chemical mechanical planarization (CMP) and UV curing, the effects of feature architecture including length-scales and aspect ratios, and finally, consideration of operating environments.

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