Polymers for Big Science: free-standing films and low-stress CVD materials at the National Ignition Facility

Salmaan H. Baxamusa, Staff Scientist, Lawrence Livermore National Laboratory

Big Science is often considered the realm of experimental physics research, but underlying these complex experiments are the materials that enable scientists to push the boundaries of known physics. This talk will describe two examples of polymer science and engineering used in experiments at the National Ignition Facility (NIF), a laser facility where matter is studied at densities and pressures found in nuclear fusion and astrophysical phenomena.

In the first example, we developed a process for fabricating ultrathin free-standing polymer films as thin as 15 nm. These films are self-supporting over macroscopic length scales and can support external loads up to 10,000× their mass. These films are now used daily in the fabrication of laser targets fielded at the NIF.

In the second example, we discuss the aging and chemical stability of polymers deposited via chemical vapor deposition (CVD). Polymers synthesized with plasma CVD have outstanding thermal and mechanical properties, but we have discovered an unusual photo-oxidation in these materials caused by low-energy visible photons. New polymers deposited with hot filament, rather than plasma, CVD have greater photostability yet mimic the thermal and mechanical stability of plasma CVD polymers. The hot-filament deposited materials display remarkably low film stress, enabling the deposition of thick layers.

Through these examples, this talk will show that polymer science is not only important for, but is in many ways enabling, scientists to study one of the most difficult experimental physics problems of today.

Prepared by LLNL under Contract DE-AC52-07NA27344.

LLNL-ABS-719306