Introduction to Advanced Transportation

Fundamental research can play a role in reducing greenhouse gas emissions associated with growing global transportation energy use by enabling technologies that either significantly reduce the energy requirement of transportation or reduce greenhouse gas emissions associated with the fuel chain. Reducing the energy requirement for transportation may be accomplished by reducing vehicle mass, smoothing the operational speed profile, and reducing viscous and contact friction. Specific technical challenges in these areas include the low-cost production of high-strength, low-weight materials and the technical foundation to enable automated vehicles.

Fuel chains with low net greenhouse gas emissions include portable storage of low-carbon electricity and carbon-based fuels synthesized from low-carbon energy. Significant technical challenges in this area include developing batteries with high energy density and stability, and developing classes of low-cost catalysts capable of efficiently converting low-carbon energy into and out of forms amenable for portable storage. There is currently one active program in this area that addresses the problem of electrical storage in light-duty electric vehicles.

A project that began in 2015 led by Professor Dauskardt is aimed at examining vehicle light-weighting with polymeric glazing and moldings. There is a strong desire in the transportation community for a molding process, which would allow a wider range of shapes and aerodynamic designs in addition to providing weight reduction. The team is working on improving the durability, performance and lifetime of the material and its processes. The team uses an experimental approach towards a manufacturing method based on atmospheric plasma deposition and performs detailed surface analytical measurements and targeted physical testing. In the first year the researchers demonstrated a deposition method that fabricates coatings in a one-step process, significantly overcoming challenges in what is typically a three-step process. In the last year they have focused on creating mechanically robust polymeric glazing that offers UV-protection to the underlying polymer substrate. Two strategies were used to achieve this: incorporation of nanoparticles into a host plasma deposited organosilicate matrix and; direct deposition of UV-absorbing organosilicate coatings using a dual precursor. The resulting films show high transparency in the visible range while absorbing a significant amount of UV light. The mechanical properties of these films are not compromised and in some cases are enhanced.