Spherical Indentation of Composite Materials

Tensile, compression, and bending tests are conventionally used for mechanical characterization and certification of a wide variety of materials used in many engineering applications. However, these standardized tests demand relatively high cost in resources (large volumes of material) and labor time (i.e. specimen fabrication and experimentation). Motivated by the need to find alternative methods for extracting reliable mechanical properties that substantially reduce these costs, our research group has been developing spherical indentation test protocols. Sample preparation for spherical indentation only requires a flat relatively undamaged surface, and depending on the indenter size, many tests can be performed on respectably small volumes of material. Recent years of research in this field has enjoyed tremendous success in metallic samples\(^1\)\(^-\)\(^3\), and we have started to explore spherical indentation on other fundamentally different material systems such as polymer matrix composite (PMC) materials.

Two projects are available, and they are both on PMCs. These PMCs were received from collaborators at Indian Institute of Science (IISc). They are investigating innovative ways to produce advanced material systems, but mechanical characterization remains to be a significant challenge. The objective of this research work is to employ spherical indentation analysis protocols to characterize these materials where only limited material volumes are available. Through this opportunity, the student will 1) gain experience in the lab such as sample preparation, spherical indentation, microstructure imaging (as well as image analysis via MATLAB/python), 2) obtain insight on the current bottlenecks that prevent faster development in materials design, and 3) open up possible avenues for continuation of this work (masters or PhD).

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