Lecture Title: Sample preparation for Transmission Electron Microscopy in Materials Science

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An adequate specimen preparation is the first step for successful transmission electron microscopy (TEM) experiments: high quality TEM specimens are required to achieve structural information at the ultimate atomic resolution, today allowed by modern electron microscopes.

Specimens for TEM experiments must be thin in a range between some nm to a few hundreds of nm, remaining mechanically stable, representative of the properties of the whole materials and free from artefacts.

The reduction of specimen thickness is something between craft and science and requires both human skills and dedicated instrumentation.

In this lecture, TEM sample preparation techniques for different classes of materials will be discussed, with the help of some examples. In particular, the preparation of planar and cross-sections, starting from bulk samples, will be described, with reference to different types of materials, ranging from hard matter, like GaN, SiC or sapphire, to brittle semiconductors, like GaAs. Also, the preparation of TEM specimens starting from powders or nanomaterials dispersed in a liquid will be reported. Finally, site-specific TEM lamella preparation by focused ion beam (FIB), necessary for the preparation of samples with complex structure, like modern microelectronic devices, will be presented. The critical issues of preparation induced damage and artefacts, like amorphization, strain, chemistry modification, generation of structural defects, will be discussed. The most recent advances in the instrumentation and preparation procedures will be covered.