ABSTRACT:

Pressure-Dissolution-Induced Structural Defects in Ferroelectric Perovskites

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Understanding materials at the level of processing – structure – properties interplay is crucial for their development and progress. Ferroelectric perovskites that are produced via the cold sintering technique are marked by the pressure-dissolution process and pressure-induced plastic deformation. These mechanisms trigger partial dissolution of the ceramic particles at the contact points and their interpenetration, migration of the dissolved matter and its precipitation in voids, allowing healing of the particle compacts into bulk ceramics and its densification. We discover unique structural features in cold-sintered ferroelectrics that could potentially be manipulated to tune the materials' functional responses. These features include strongly etched grain-boundary contacts with interlocking grains, crystal-lattice defects (i.e., lattice bending, edge dislocations and faults), dynamically-stable open-pore-channel frameworks, nanometre-sized closed pores that are bound to kinked grain boundaries and dislocations, possible nanosized precipitates, and changed oxidation states with likely reduced ionic species. Understanding the formation of these structural defects, their impact on ferroelectric properties and possibilities for their manipulation is a challenge that we undertake.

In this presentation I will show the microstructures of the imprinted structural defects in cold-sintered ferroelectric ceramics, observed down to the atomic scale. Suggestions about their formation and interactions between defects, grain boundaries and domain walls will be given. The impact of microstructure and post-annealing on the functional properties (i.e., conductivity, dielectric losses, polarization and strain) will also be discussed and possible novel applications for cold-sintered materials will be foreseen.