Exploding, weeping and reversible behavior at phase transformations in polycrystalline ceramics

The systematic tuning of the lattice parameters to achieve improved kinematic compatibility between phases is an effective strategy for improving the reversibility, and lowering the hysteresis, of solid-solid phase transformations.
Thus, it came as a big surprise, in joint work with Eckhard Quandt and his group in Kiel, that our attempt to use these methods to guide the search for a shape memory ceramic led not to a high degree of reversibility, but rather to violently explosive or "weeping" behavior (i.e., gradual falling apart at the grain boundaries) in oxides of ZrHfYNb.
In the lecture I will review the theory of supercompatibility and its applications, and then turn to the puzzle of ZrHfYNb.
Several aspects of this system are unusual -- multiple transformation correspondences (also seen in TiNi) and unusual symmetries – and we analyze the behavior in light of these features. Overall, our results show a diversity of behavior, from reversible to explosive, is possible in a chemically homogeneous system by slight manipulation of conditions of compatibility.