Transformational monochalcogenides

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Group-IV monochalcogenides have recently been reported to host several unconventional (and sometimes conflicting) properties. Their different phases directly stem from a delicate interplay of ionic and covalent bonds, which can lead to structural instabilities, ultimately manifesting in a change of functional properties.

In my seminar, I will focus on SnSe and SnTe as prototypical examples. I will show how structural instabilities can accommodate a large variety of electronic structures in these materials, which can range from metallic to insulating.

In particular, by combining molecular beam epitaxy with variable temperature scanning probe techniques, I will demonstrate how it is possible to drive a transition between a rock-salt structure which is topologically non-trivial to a rhombohedrally distorted structure which is polar and can form a ferroelectric phase. Moreover, I will show that reducing the thickness is accompanied by a substantial enhancement of the ferroelectric transition temperature, reaching values higher than room temperature for monolayer SnSe.

Finally, I will briefly discuss future directions based on the use of these fascinating materials in vertical as well as horizontal heterostructures.

SHORT BIO*: Dr. Paolo Sessi is Group Leader at the Max Planck Institute of Microstructure Physics (Halle, DE). He received PhD in Physics and MSc in Electronic Engineering from Polytechnic University of Milan in 2010 and 2006, respectively. Before moving to MPI, Paolo worked t at the Center for Nanoscale Materials, Argonne National Laboratory and at the University of Würzburg, Germany. Paolo has extensive experience in the design and construction of advanced scanning probe set-ups operating at extreme conditions, such as ultra-low temperatures, ultra-high vacuum and high magnetic fields. Paolo's activity is focused on visualizing spin-orbit driven phenomena at surfaces and interfaces at the atomic scale. His current research topics include novel topological states of matter, non-collinear spin textures, and 2D ferroic materials.*