The new paradigm of transmission electron microscopy – on the way to the ultimate limits of optics

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Seventy years after its invention by Ernst Ruska transmission electron microscopy has entered a dramatic phase of development and has set out to quest for the ultimate limits of microscopies. The key to this is the recent introduction of aberration-corrected electron optics opening up the way to atomic-resolution electron microscopy in the sub-Angström range. Since the images obtained this way are based on quantum physics their content can only be understood quantitatively on the basis of a comparison with proper solutions of the Schrödinger equation. This way novel investigations on defect structures e.g. in oxides, superconductors and ferroelectrics have become possible in which one not only can determine the local oxygen content on the atomic level but also one can measure atomic displacements at an accuracy of a few picometers. Concentrating on examples of recent work on perowskitic dielectrics the lecture will provide an introduction to this exciting field and elaborate on the limits set by the width of the electron wave function.

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