Ultramicroscope (UM) was invented and developed more than 100 years ago by Zsigmondy and Siedentopf. The basic idea was a visualization of objects smaller than the resolution limit of classical microscopes exploiting light scattering by particles under the perpendicular (dark field) illumination. Nowadays, some of the novel techniques breaking the diffraction resolution-limit (so called super-resolution techniques) remind principles of the ultramicroscope - for example STORM (Stochastic Optical Reconstruction Microscopy) – based on the localization of single emitting centers (molecules, nanoparticles).

This contribution presents our innovative home-built ultramicroscope, which contains a special dark-field illumination system based the axicon lens (lens with one conical and one flat surface, often used to generate Bessel beams). The axicon transforms the illumination laser beam into cone focused on the sample image plane by an objective. This provides oblique illumination of the sample which acts as a dark-field illumination if combined with an objective lens with the appropriate numerical aperture. The setup is assembled from commercially available optomechanical components, which makes the construction of the ultramicroscope relatively easy and adaptable to various applications. We demonstrate the properties of our ultramicroscope by performing scattering and fluorescence measurements of semiconductor nanoparticles. In our assembly is possible qualitative and quantitative analysis of the sample.

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Fig. 1: Simplified schematic diagram of the ultramicroscope