The global trend in renewable energy investment is developing the new energetic system using hydrogen; well known as a hydrogen economy. The key devices seem to be the fuel cells (FC) that convert chemical energy from hydrogen or hydrocarbons into kinetic or electrical energy. The most critical component of the FC is catalyst. The versatile element in catalysis is platinum (Pt) that efficiently mediating a multitude of chemical reaction. Unfortunately, Pt is rare element and its high price, exceeded that of gold, limits large-scale applications. Therefore, not surprisingly, the goal of reducing the amount of Pt is the major driving force in the catalysis research.

The Pt - CeO₂ porous layers have been reported to be significantly active catalysts for CO oxidation, hydrogen production and oxidation of ethanol. Thin – film technology permits to produce large variety of hetero-materials with different composition (low concentration of platinum) and morphology (porous structure) of layers. The knowledge of the materials structure is fundamental for the best understanding of their physical and chemical properties. The key role of carbon in the porosity creation of the catalyst layer is presented. The morphology of the CeO₂ films prepared by magnetron sputtering on graphite foil was investigated by using microscopy tools – the Atomic Force Microscopy (AFM), the Scanning Electron Microscopy (SEM) and the Transmission Electron Microscopy (TEM). These studies show modification of carbon, confirmed by the Energy-Dispersed X-ray Spectroscopy (EDX) – see Fig. 1. The formation of cerium carbides crystals on the catalyst-substrate interface was observed using the High-Resolution TEM (HR-TEM). Moreover, the reduction of cerium as a result of the interaction with the carbon support was obtained by spectroscopies – the X-ray Photoelectron Spectroscopy (XPS) and the Electron-Energy Loss Spectroscopy (EELS). Finally, the structural model of the system is designed.

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Fig. 1: The modification of carbon after deposition of 20nm thick CeO$_2$ layer on graphite foil - a) the material contrast obtained by the Scanning Transmission Electron Microscopy (STEM), b) the element map obtained by EDX.