SUMMARY

Titanium dioxide has been studied for many years, regarding its interesting properties and wide range of applications. This oxide belongs to the semiconductors exhibiting n to p transition. The transition point depends on both temperature T and oxygen activity, $p(O_2)$. The n-type conductivity is observed for either undoped, strongly reduced or donor-doped material. Both undoped and acceptor-doped rutile show n- to p-type transition at higher $p(O_2)$. There are two competitive models explaining this transition. One of them, known as ‘extrinsic model’, assumes an excess of acceptor-type impurities in this material, while the second one suggests the influence of titanium vacancies resulting from either Frenkel or Schottky disorder on charge compensation within $p(O_2)$ range close to n-p transition point.

It was found that equilibrium of Frenkel or Schottky reactions (playing a role as Ti-vacancies source) occurs above 1700 K. At lower temperatures (below 1400 K) the equilibrium remains in frozen state. It means that the concentration of titanium vacancies is independent of $p(O_2)$. Author created defect diagrams remaining in good agreement with experiment.

A mixed electronic-ionic conduction is observed at the $p(O_2)$ range close to n-p transition point. Ionic component of the electrical conductivity is independent of $p(O_2)$ and reaches the values comparable with electronic conductivity. So, neglecting the ionic contribution in total conductivity leads to wrong results of determined semiconducting parameters. The effect of the ionic conductivity on determined electrical forbidden energy gap was shown, as an example. Also, the impact of the ionic conductivity on the shape dependencies of total electrical conductivity *vs* $p(O_2)$ was discussed.

Author constructed an electrochemical cell TiO_2|electrolyte|Pt. This cell enables to study photoelectrolysis of water induced by solar-simulated light. It was found that TiO_2 thin film electrodes exhibit high energy conversion coefficients comparable with that of single crystal electrode. This fact gives an opportunity to replace very expensive single crystals by cheaper thin films.