

## Characterization of graphene synthesized by electrolysis in aqueous electrolytes

Aleksandar Petrovski, Aleksandar T. Dimitrov, Anita Grozdanov, Beti Andonovic and **Perica Paunović**

Faculty of Technology and Metallurgy, University "Sts. Cyril and Methodius"  
RugerBošković Str., 16, 1000 Skopje

pericap@tmf.ukim.edu.mk

Electrochemical approach is a suitable alternative for a high-yield production of graphene. Electrolysis in aqueous electrolytes is simple, environmentally friendly, economic, as it occurs under ambient conditions, and flexible process, due to the thickness control by potential or current adjustment, providing synthesis of high quality graphene.

The studied graphene material was produced by electrolysis in acid aqueous electrolysis using reverse change of the applied voltage. Highly oriented graphite was used as electrodes (precursors for graphene production). Three types of electrolytes were used:  $\text{H}_2\text{SO}_4$  (pH = 0.5),  $\text{H}_2\text{SO}_4 + \text{KOH}$  (pH = 1.2), and  $\text{H}_2\text{SO}_4 + \text{NaOH}$  (pH = 1.2).

Characterization of the synthesized graphene was performed by means of scanning and transmission electron microscopy (SEM and TEM), infrared spectroscopy (FTIR), thermal analysis (TG, DTA and DTG), Raman spectroscopy and X-ray diffraction (XRD). Determination of crystallite size and number of graphene layers was done using Raman and XRD spectra. It was found that the dominant structure is few-layered graphene, with an average value for number of graphene layers calculated as  $n = 3.53$ , whereas the number of graphene layers for the overall graphene structure was calculated as  $n = 5.6$ .

**Key words:** graphene, electrolysis, aqueous electrolyte, layers, crystallite size.