Contribution ID: **1124** Type: **Oral**

Oxygen moieties on GO and GO/WPA nanocomposites after thermal treatment and chemical titrations

Wednesday, 26 October 2022 15:30 (15 minutes)

Nanocomposites have enriched modern material systems, contributed to sustainable progress in material science and engineering and improved quality of living. Among other aspects, the surface chemistry of nanomaterials is very important for preparation of nanocomposites. In this study we have analyzed the change in surface chemistry of graphene oxide (GO) and its nanocomposite with 12-tungstophosphoric acid (WPA, 5 to 50 wt.% of WPA, nominally). For modification of oxygen moieties, a chemical titration (NaOH, Na2CO3, NaHCO3) and thermal treatment (T=450 oC, in Ar) were selected. Fourier-transform infrared spectroscopy (FTIR), X-ray photoelectron spectroscopy (XPS), temperature programmed desorption (TPD), zeta-potential and adsorption of methylene-blue measurements were used for monitoring the changes of surface chemistry. The chemical titrations revealed that the presence of WPA affects the ability of surface oxygen groups to transfer protons, which is manifested by widening and merging of the peaks in the first derivative of titration curve. This behavior was observed in the case of composites with a higher WPA content (50 wt.%). Adsorption of methylene blue has shown that in the case of pure graphene oxide, oxygen groups have a positive effect. In the case of composites, the presence of WPA is advantageous because the adsorption capacity is improved compared to the initial GO. Also, it can be concluded that titration improves, while thermal treatment completely blocks the adsorption capacity of nanocomposite. These results improve the understanding of interaction between GO and WPA in suspensions, which is the initial step in the preparation of solid-state nanocomposites.

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Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics