Laser fabrication of nanocarbon-based hybrid electrodes for supercapacitors

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Low dimensional carbon materials, particularly graphene derivatives and carbon nanotubes (CNT), in combination with transition metal oxide (TMO) nanostructures are being intensively investigated for energy storage applications due to their outstanding physical and chemical properties [1,2]. The synthesis of this type of materials through conventional methods can reveal drawbacks as chemical incompatibilities, solubility limitations or problems for producing additional compounds in contact with thermally sensitive materials. Alternatively, localized extreme heating produced by pulsed laser radiation appears as a valuable tool for rapid, non-toxic and versatile synthesis of these compounds [3,4].
The aim of this presentation is to show results concerning the development of CNT-TMO and reduced graphene oxide-TMO-based hybrid materials obtained through direct laser irradiation as well as matrix assisted pulsed laser evaporation (MAPLE) techniques. Structural characterization and thermal simulations reveal that the laser irradiated materials (CNT, graphene oxide, TMO nanoprecursors) undergo ultrafast heating mechanisms, reaching very high temperatures in confined regions. These extreme conditions promote the activation of extensive thermochemical processes in addition to selective recrystallization of the nanostructures, leading to the synthesis of a rich diversity of nanomaterials. The effects of the laser radiation on the structural as well as supercapacitive energy storage properties of the irradiated / deposited electrode materials will be discussed.

References

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Figures

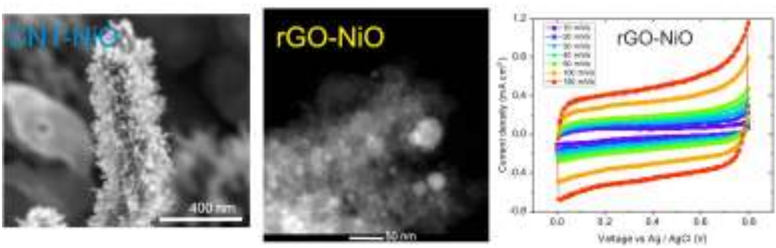

Figure 1: SEM image of CNT-NiO and STEM image of reduced graphene oxide (rGO)-NiO materials, as well as cyclic voltammetries of rGO-NiO electrode.