Project No. 02307 / Grant No. JPMXP0723833151

Report form of Joint Research Project at ZAIKEN (FY2023)

Title of Project	Advanced composites based on TiS_2 and graphene oxide (GO) as versatile capacitors		
Priority Area	III-A(Energy saving & Processes), III-B(Energy saving & Structure), III-C(Energy saving & Properties)		
	New proposal		
Name of Main Applicant	GUEGAN Régis		
Institution	Université d'Orléans	**title**	Assoc. Prof.

Aim of the research project

Due to their excellent conductivity, moderate band gap and good mechanical strength, transition metal dichalcogenides (TMDS) represent versatile materials for possible applications in the field of energy: electrodes, and or supercapacitor for instance. Their conductivity is principally driven by the concentration of charged impurities, while the band gap can be adjusted by controlling the number of TMDs nanosheets. The improvements their properties can be significantly enhanced through their association with further 2D nanocrystals or nanosheets such as graphene or reduced graphene oxides (rGO). The purpose of the research project consisted in the synthesis of rGO/TiS_2 composites for different ratio and lateral size of the components and to determine their electrochemical properties after a fine characterization of their structures and morphologies.

Contents and results of the research

1. Graphite oxide was synthesized based on the modified Hummer's method and was also thermally reduced
2. Graphene oxide (GO) was properly dispersed in aqueous media at a concentration
3. The lateral size of GO nanosheets could be drastically reduced by using ultrasonic treatment
4. Titanium disulfide nanosheets were successfully synthesized from a TiS_2 powder and the intercalation of Li^+ ions within the layered material leading to the delamination of $LiTiS_2$ nanosheets as supported by complementary analyses
5. As for GO, the lateral size of TiS_2 nanosheets was reduced as well by using ultrasounds at high power
6. Due to their opposite electrical charges, both GO and $LiTiS_2$ nanosheets were easily associated in a colloidal dispersion
7. The different GO-TiS2 composites were characterized by a set of complementary techniques: TEM, SEM and the electrochemical properties were also determined
8. The resulting nanocomposites exhibited different organization depending on the lateral size of the individual GO and TiS_2 nanosheets
9. The electrochemical properties of the nanocomposites appeared to be enhanced in contrast to bulk GO

Outputs of the project (publications, presentations, patents)

A paper is currently under preparation and will be submitted as soon as possible