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## Physicochemical properties of Ti-based MXenes obtained from SHS synthesized MAX phases and their application for energy storage

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**M**Xenes attract attention as electrodes for energy storage applications e.g. for supercapacitors. The problem is that the methods of MXenes preparation described in the literature are often multi-stage and complicated. So, the purpose of our work was the development of more simple and technologically acceptable method of MXenes preparation. In the literature, the synthesis of MAX phases (precursors for MXenes synthesis) has been realized by different methods. We used one stage self-propagating high-temperature synthesis (SHS) that seems most suitable due to simplicity, short reaction time, cost-effective and little demand on external energy. Commercially available Ti, Al and carbon black powders were used. Several phases (mainly  $Ti_3AlC_2$ ,  $Ti_2AlC$ ,  $TiC$ ) were among the products after SHS. Obtained products are crushed in a roll crusher and then automatic agate mortar. For Al etching from the MAX phase a dilute solution of HF was used. Then delamination of MXenes in N,N-dimethylformamide and isopropanol mixture with sonication were lasted for three days. The content of unreacted MAX phase particles in MXene powder can be reduced by using hydrocyclone assembly and alcohol medium instead of water. Suspension stability of MAX phase particles decreases rapidly while suspension of MXene particles is fairly stable. Also, alcohol medium can protect  $Ti_3C_2Tx$  Mxene from oxidation. Since both layered  $Ti_3C_2Tx$  and  $Ti_2CT_x$  obtained can be used as electrodes for supercapacitors, SHS method is suitable for  $Ti_x + 1AlC_x$  phases preparation. In 1 M solution of  $Na_2SO_4$  obtained electrodes demonstrated gravimetric capacitance up to  $220 \text{ F g}^{-1}$  at charge-discharge rates  $2 \text{ mVs}^{-1}$ .

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