# Scalable self-propagating high-temperature synthesis of graphene for supercapacitors with superior power density and cyclic stability

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Under the financial support from the National Natural Science Foundation of China and the Chinese Academy of Sciences, the research team led by Prof. Ma Yanwei (马衍伟) at the Institute of Electrical Engineering, Chinese Academy of Sciences, proposed a scalable self-propagating high-temperature synthesis of mesoporous graphene for supercapacitors with ultra-high power density and cyclic stability, which was published in *Advanced Materials* (2017, 1604690).

The tremendous growth of high-power systems has prompted urgent demand for supercapacitors. Graphene holds great promise to spark revolutions in future supercapacitor electrodes benefiting from its excellent electrical conductivity and chemical stability. Current protocols for graphene mass-production heavily rely on the exfoliation of expanded graphite and the reduction of graphite oxide. However, the former method usually produces stacked graphite flakes with low specific surface area, while the latter generally introduces numerous oxygen groups and defects, leading to low electrical conductivity. Therefore, it is urgently desired to develop a straightforward and green technique for production of high-quality graphene.

To solve this problem, Prof. Ma's group turned to a competing alternative technique called self-propagating high-temperature synthesis (SHS), which utilized a controlled exothermic reaction between $CO_2$ and Mg. The SHS protocol for graphene production is time-efficient, environment-friendly, low-cost and readily scalable in industrial occasions, and the graphene products show excellent physiochemical properties. The specific surface area of graphene by SHS can reach 709 $m^2 g^{-1}$, and its electrical conductivity is as high as 13000 S $m^{-1}$.

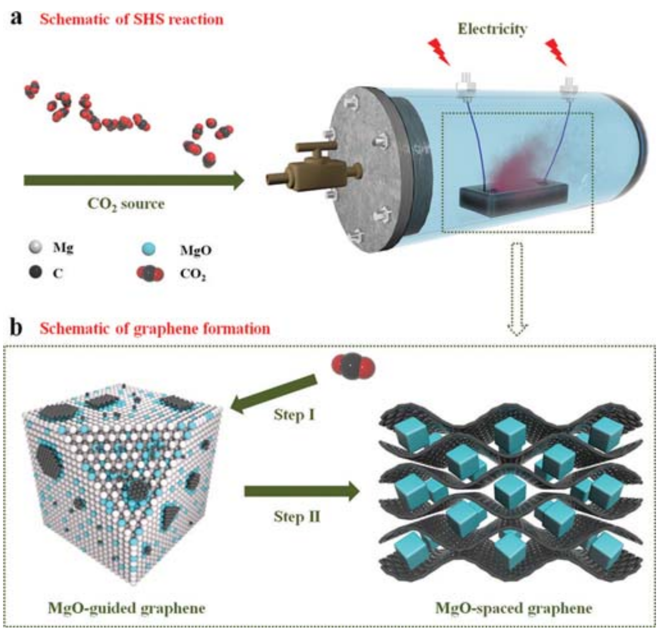


**Figure** A schematic illustration of the SHS process.

The graphene obtained by SHS exhibits superior electrochemical performance as supercapacitor electrode in ionic liquid electrolytes, which delivers a high capacitance of 244 $Fg^{-1}$ and an energy density up to 136 Wh $kg^{-1}$. Even at a high operating power density of 1, 000 kW $kg^{-1}$, the electrode still presents an energy density of 60 Wh $kg^{-1}$. Furthermore, we have demonstrated an excellent electrochemical stability where the capacitance retention of 90% is achieved even after 1 million cycles. The integration of both high power density and long cycle life enabled by the proposed SHS technique in *Advanced Materials* paves a path for graphene applications in power supply systems operating at high rates.