Magnetic iron carbides from readily available biopolymers

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Iron carbide can be used in a wide variety of fields ranging from steel hardening over catalysis to magnetic imaging techniques employed in the frontiers of medicinal research. Thus there is a heightened interest for facile and easy synthesis routes to this advanced material.

Biopolymers such as gelatine have recently been reported to give good results in the synthesis of iron carbide.[1, 2] Advancing from this we developed a template free cellulose-based route to iron carbide nano-particles in a high surface area carbon matrix, allowing to retain the macroscopic structure of the cellulose structure (see Fig. 1). For this a certain amount of cellulose is immersed in an aqueous iron acetate solution and subsequently calcined at 600 – 800 °C.

The resulting composite, a mesoporous flower-like graphitic carbon matrix with embedded iron carbide nano-particles, had a surface area up to 300 m\(^2\)/g with an average pore diameter of 3.4 nm.

This novel structure exhibits the good magnetic properties related with iron carbide and could be employed a catalyst in ammonia decomposition process (see e.g. [3]). In our contribution we will also show that based on the cellulose system any three dimensional shape can be prepared, since the shape of the cellulose template is retained on any scale. The shaping can be done for example by folding pure cellulose paper into the desired shape and soaking the structure in the iron precursor solution.

![Fig. 1: Left: TEM (ultra microtome; scale bar equals 200 nm) of iron carbide particles in carbon matrix; Right: SEM of cellulose fibres before (A) and after (B) calcination.](image)