Preparation of carbides using 2D nanostructured waste by-products and their utilization as reinforcements in HEAs

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Current research focuses on cutting-edge high-performance materials prepared using various advanced methods[1–5]. The chosen preparation method can significantly affect the properties of the same material, often due to microstructural refinement and reinforcement with hard particles. However, limited information is available on the targeted preparation of reinforcing particles using nanostructured carbon-based precursors[7]. These particles can be produced from 1D and 2D carbon materials, such as carbon nanotubes (CNTs) and graphene. The potential of these materials is demonstrated by the increasing effort to use them as strengthening agents in high-entropy alloys (HEAs)[6–10], particularly for their ability to suppress crack formation and hinder its propagation. Graphene, for example, exhibits excellent electronic, mechanical, and thermal properties[11].

However, the use of 1D and 2D carbon-based materials is often costly. A new, more economical source, typically considered a waste by-product of polypropylene cracking (turquoise hydrogen production), shows promise as a candidate for enhancing the properties of alloy systems like HEAs. This by-product, characterized by spherical particles around 40 nm in size and with a high specific surface area[1]2, could be a valuable alternative to expensive materials like graphene or CNTs. A deeper understanding of the phase formation kinetics, morphology, and microstructure during mechanical alloying could open a new approach, utilizing this common waste by-product to create reinforcing particles.

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