

TEM Study of mechanically alloyed ODS steel powder

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Compared to present reactors, modern nuclear power plant concepts are based on materials which can be operated at higher temperatures and up to higher neutron doses. Oxide dispersion strengthened (ODS) steels – produced by mechanical alloying – with chromium contents of 9 and 14 wt. % (or even more) are typical candidate materials.

As the preparation of TEM samples from milled powders is usually very difficult, a new approach has been successfully adopted coming from the TEM sample preparation of biological tissues. Here, the alloyed powder is first embedded and then cut into thin films of 60-90nm thickness using a microtom. The focal point is to gain a better knowledge of the solution mechanism of Y_2O_3 in the steel powder during mechanical alloying. Investigations on mechanically alloyed powders containing 13% Cr and Y_2O_3 were made using a Tecnai Scanning Transmission Electron Microscope (STEM) with EDX detector.

Detailed elemental mappings of the powder particles show the presence of Y_2O_3 particles after different milling times. The non-dissolved Y_2O_3 phase was detected on the surface of the mechanically alloyed powder particles in the specimen alloyed at times down to 24 hours. After mechanically alloying of 80 hours, no Y_2O_3 phase has been detected. Inside the mechanically alloyed powder, no particles were detected.

All further results of the elemental mappings after different milling times are analyzed, compared, and discussed in this paper.