

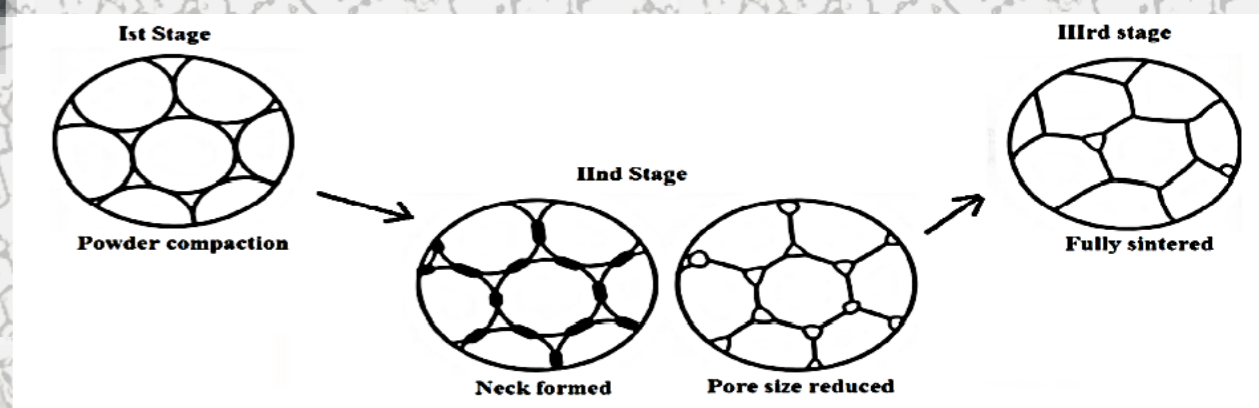
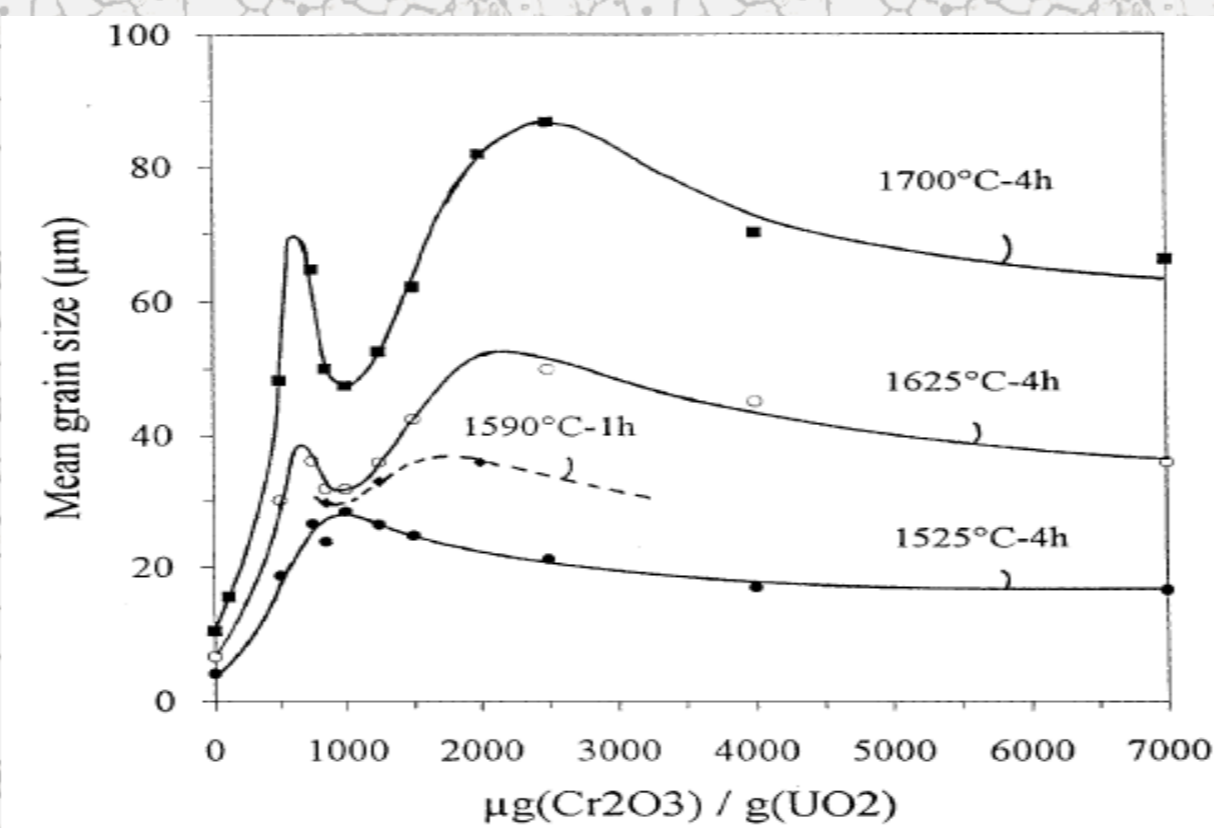
Production and characterisation of chromium(III)-doped UOX pellets via dry mixing

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Master of nuclear engineering technology

Introduction

In recent years, chromium(III)-doped pellets have been introduced to market. As part of the DisCo project, the SCK·CEN was tasked with the production and characterization of these pellets. Chromium(III), added as Cr_2O_3 , leads to increased crystal grain sizes after sintering.

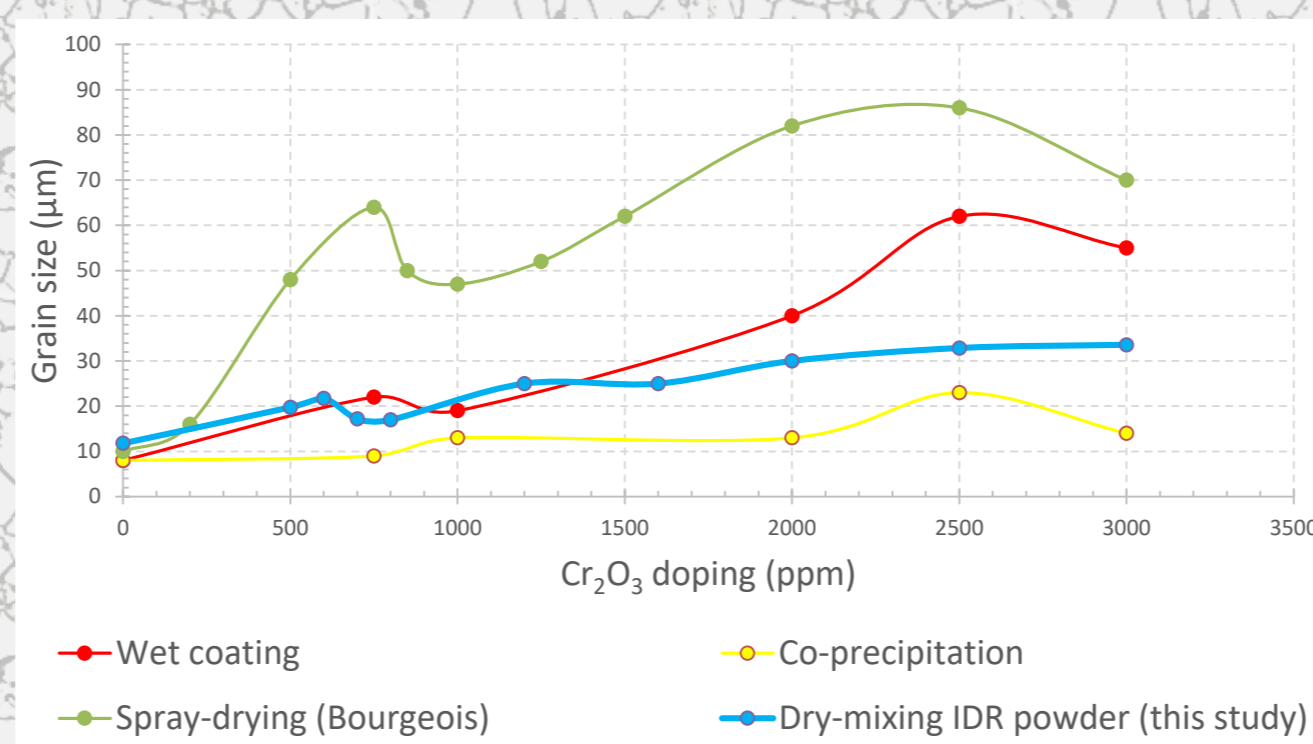


Sintering

UOX pellets are made with a three-phase process called sintering. Chromium(III) introduces more vacancies in the uranium and provides a liquid phase which creates larger crystal grains in the uranium.

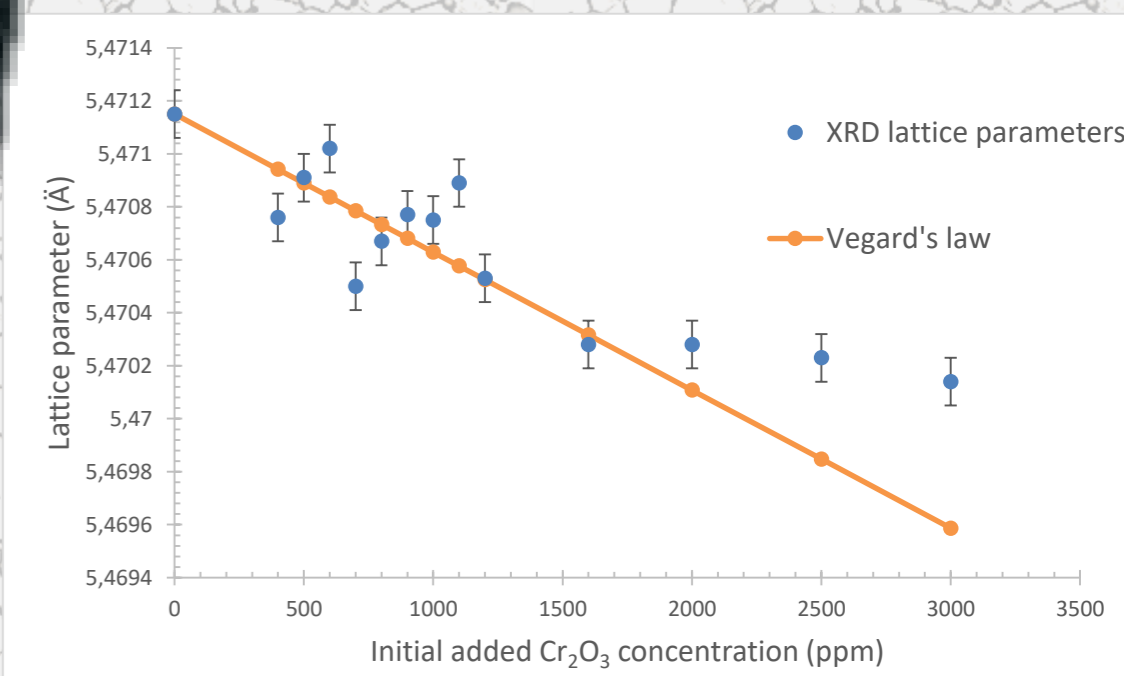
Etching

To determine the crystal grain size of a UOX pellet, the surface of a pellet is first polished to a mirror finish and then etched with a HF solution. This reveals the individual grains and allows for size determination using a microscope.



Different ways of adding Cr_2O_3 yield different grain sizes. We have obtained a maximum average grain size of 33 μm .

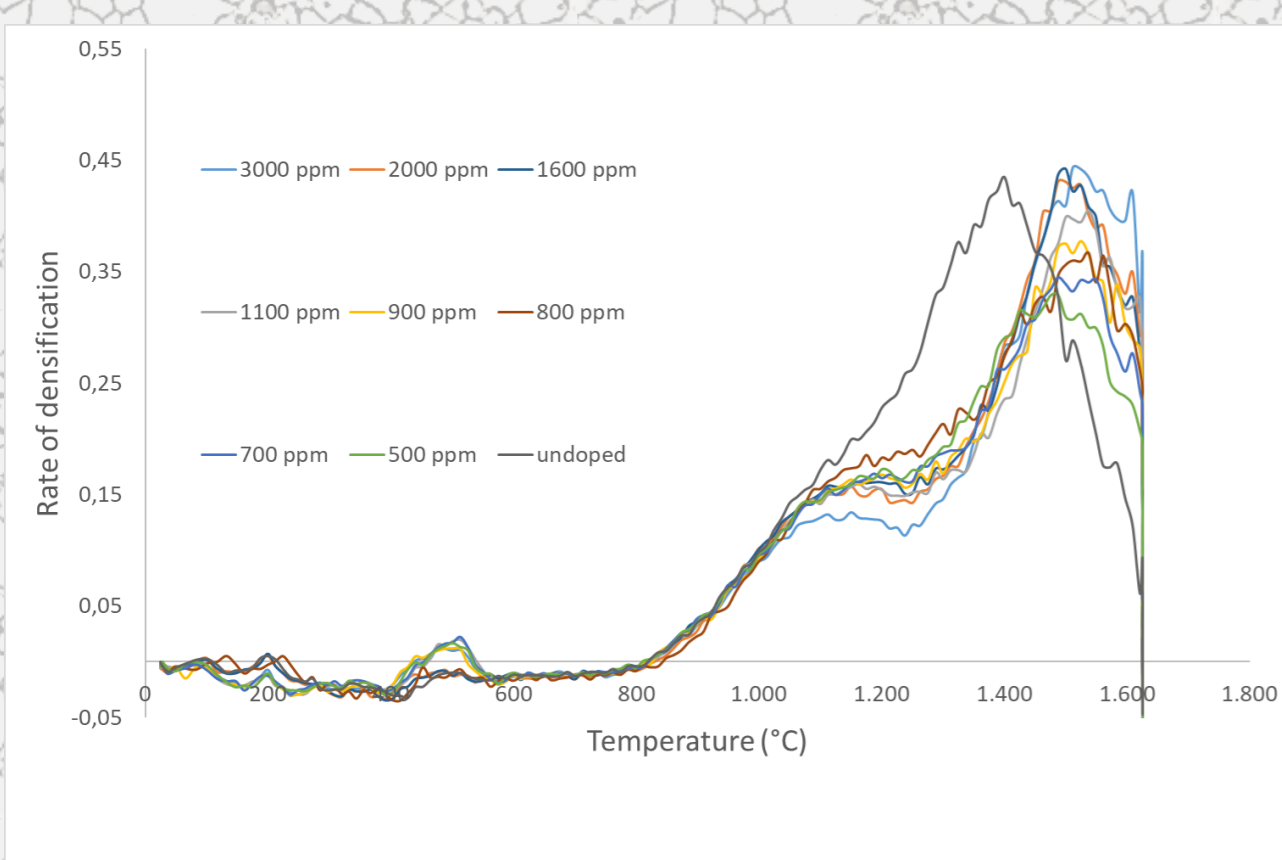
XRD and EPMA



XRD shows that the lattice contracts as chromium(III) is dissolved, but this contraction plateaus at the solubility limit. EPMA shows the distribution of chromium(III), which is rather inhomogenous.

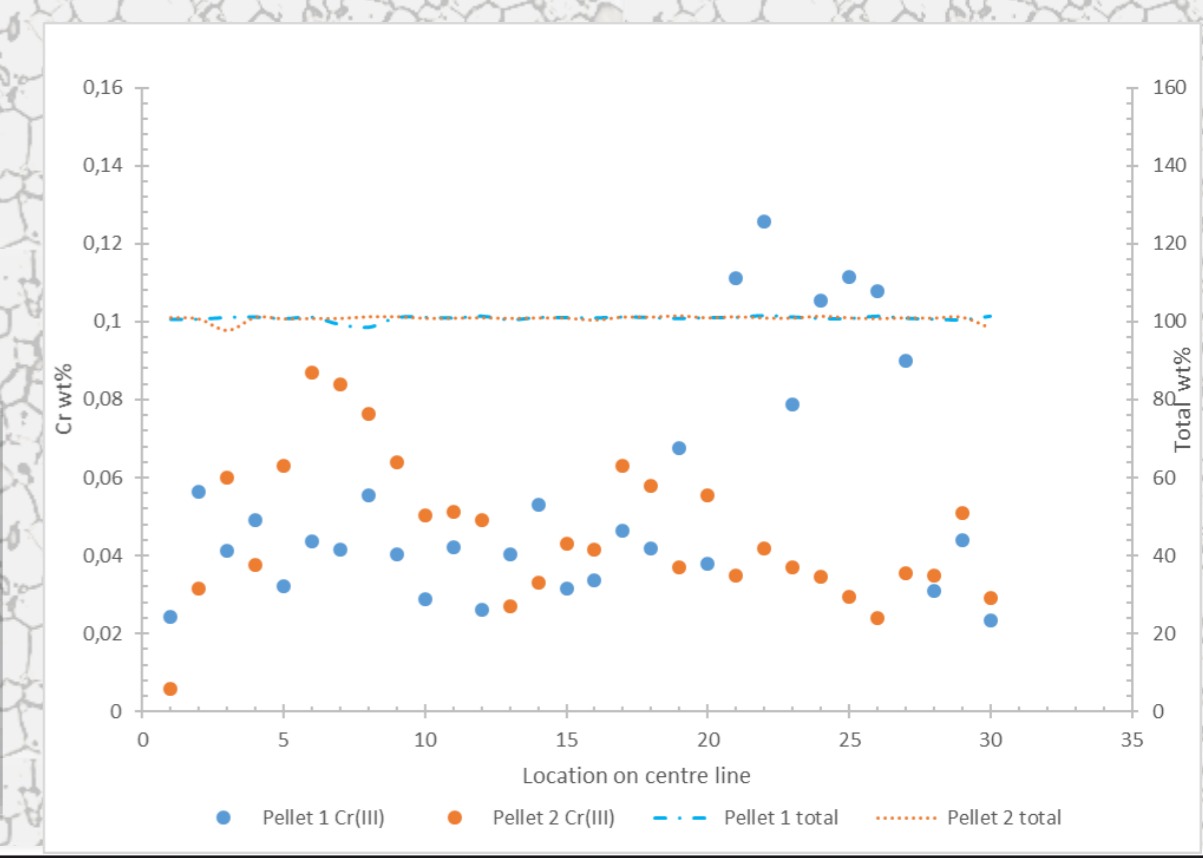
Dilatometry

Chromium(III) introduces a plateau in sintering speed and shifts the peak in sintering rate upwards by 200 °C



Conclusion

Chromium(III) can be added as a dopant to UOX fuel to obtain larger crystal grains by influencing the sintering behaviour of UO_2 . The long-term storage of these large-grain pellets is the focus of current research, and the SCK·CEN can produce these pellets as necessary.



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(1): L. Bourgeois, P. Dehaut, C. Lemaignan, and A. Hammou, "Factors governing microstructure development of Cr_2O_3 -doped UO_2 during sintering," *J. Nucl. Mater.*, vol. 297, no. 3, pp. 313–326, 2001.