Introduction

The blanket of a fusion reactor (see Fig. 1) has many functions, necessitating the following properties in any material used:

- Good mechanical performance
- Resistance to radiation damage
- Wide operating temperature range to maximise thermodynamic efficiency
- Compatibility with coolant and tritium breeding system

Low activation alloys

- Fusion reactors should aim to minimise long-lived radioactive waste produced
- Desirable elements are only active for <50 years (see Fig. 2)
- **Alloy design rationale 1:** use only low activation elements

High entropy alloys (HEAs)

- Relatively new class of alloys
- Characterised by multiple principle alloying elements
- Often (near-)equiatomic concentrations
- Certain HEAs confer radiation resistance[2] and unique tensile properties[3]
- **Alloy design rationale 2:** Develop HEAs based on low-activation elements

Exploring the ternary space

- A suite of ternary V-Cr-Mn alloys has been fabricated (see Fig. 3 for compositions)
- V for creep properties, high T<sub>m</sub>
- Cr for corrosion resistance, good solubility with V (both bcc)
- Mn for solution strengthening and to build towards an HEA-like system
- Ti has also been added in small amounts to act as an interstitial getter (as in V-4Cr-4Ti, another fusion alloy [4])

Stability in fusion conditions

- Alloys were homogenised for 100 hrs at 1200 °C to ensure equilibrium microstructure
- Ternary alloys comprised of a single bcc phase with vanadium oxide impurities (Fig. 4)
- Quaternary alloys contain Ti-(C,N,O) type precipitates (Fig. 5)

Future work

- Now that phase stability has been confirmed, focus is on other fusion relevant properties
- Corrosion properties and ion irradiation studies will be undertaken

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