OXIDATION-INDUCED CRACK HEALING IN Ti₂Al(1-x)SnxC SOLID SOLUTIONS

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ABSTRACT

MAX phases such as Ti₂AlC and Ti₃AlC₂ show crack healing ability, which gives rise for recovery of the mechanical properties. Healing was attributed to high temperature oxidation-induced filling of the area between the disrupted crack surfaces by formation of adhesive α-Al₂O₃ as well as TiO₂ rutile. After healing the mechanical properties can be fully recovered or even be higher than the virgin samples due to well-matched thermal expansion coefficients between adhesive α-Al₂O₃ and Ti₃AlC₂ or Ti₂AlC. In this work, materials with multiple healing ability at low temperatures as well as fast healing rates were investigated using the Ti₂Al(1-x)SnxC MAX phase solid solution system. Substitution of Al with the lower melting element Sn enhances the mobility of the A element resulting in lower healing temperatures with higher rates of oxidation. TGA-DTA measurements show the onset of crack healing to be reduced from 600 °C (x = 0) to 400 °C (x = 1). Microstructure analysis of crack filling phases confirmed the formation of SnO₂. Tailoring the MAX phase solid solution composition offers a high potential to crack healing ability in oxidizing atmosphere.