Deformation Behaviour of a High Carbon Co–Cr–Mo Medium-Entropy Alloy via Thermal Oxidation

*Rosdi Daud[1], **H. Mas Ayu[1,*]**, R. Norizah[2] & A. K. Nasution[3]*

[1] Faculty of Mechanical and Automotive Engineering Technology (FTKMA), Universiti Malaysia Pahang
[2] Department of Materials, Manufacturing and Industrial Engineering, School of Mechanical Engineering, Universiti Teknologi Malaysia
[3] Department of Mechanical Engineering, Faculty of Engineering, Muhammadiyah University of Riau, Pekan Baru, Indonesia

ABSTRACT:

Thermal oxidation is widely used in substrate surface modification before applying bioceramic coating to enhance implant resistant against corrosion and biocompatibility. In this work, mechanical and microstructural characteristics of a medium-entropy alloy $Co_{61.9}Cr_{29.6}Mo_{6.5}C_{0.24}$ (in wt.%) was thermally oxidize under controlled furnace atmosphere, at 450 °C, 650 °C, 850 °C, 1050 °C and 1250 °C for 3 h. It has been demonstrated that by oxidizing high carbon Co–Cr–Mo alloy can create a reasonably thick, stable and hard Cr_2O_3 layer on the substrate at 1050 °C. The exchange of substrate colour from silver to brownish and lastly dark green of oxide layer was observed and is evident from the variations of the surface morphology which is also a cause response to the increment of temperature. Within the interval of extremely high temperature considered (1250 °C), the alloy exhibits several unusual features, such as presence of massive porosity with clumpy blended of distinct composition of oxide layer like $CoCr_2O_4$ and $Co_{0.8}Cr_{0.2}$. The results also demonstrate that Cr_2O_3 layer recede in thickness as the temperature reaches 1250 °C and experienced oxide layer spalling due to bounteous chemosorption of O_2 atoms react with dominant elements like cobalt and chromium in the substrate.

KEYWORDS:

HC Co–Cr–Mo, Thermal oxidation, Medium-entropy alloy

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