Nitriding of AlCoCrFeNiTi0.2 high entropy alloy.

Dariusz Jarząbek[1,2]*, Mateusz Włoczewski[1,2], Kinga Jasiewicz[1], Piotr Jenczyk[1]

[1] Institute of Fundamental Technological Research, Polish Academy of Sciences, Warsaw, Poland
e-mail: djarz@ippt.pan.pl
[2] Warsaw University of Technology, Warsaw, Poland

KEYWORDS: *High entropy alloys, high entropy nitrides, nitriding, nanoindentation, ion implantation..*

ABSTRACT

Many mechanical moving components are operating in extremely harsh environments such as, nuclear energy, aerospace industries, bioapplications or advanced cutting tools. Due to the surface friction and wear at high temperatures, in a corrosive environment and/or under significant radiation the service life and reliability of these components are still suffering serious technical challenges. Hence, there is an urgent need to develop new materials, which can provide this reliability, and much recent research has focused on this topic. For example, high-entropy alloys (HEAs) are presently of great research interest in materials science and engineering.

In this paper we propose is to increase the mechanical and tribological properties of HEAs by nitriding or nitrogen ion implantation. Nitrogen atom radius is small compared to typical elements in HEAs what lead to increase of lattice distortion and creation of its own sublattice. Sluggish diffusion can be held accountable for significant inhibition of nitrogen atoms diffusion into bulk material thus increasing differences between bulk and surface layer properties. Although, there are a few papers investigating nitriding of HEA, it is still difficult to understand the appropriate choice of nitride formers for nitriding treatment. Therefore, in this work we deal with bulk material constituted by strong (Ti) and weak (Co, Cr, Fe, Ni) nitride formers as well as covalent bonding element (Al) to nitrogen. The primary objectives of this research endeavor are to unravel the intricate mechanisms governing the nitriding of high-entropy alloys and to elucidate the resulting changes in microstructure and surface properties. For these reason we use several experimental techniques – SEM with EDS and EBSD (also in transmission), nanoindentation etc.

ACKNOWLEDGEMENT: Authors would like to acknowledge the support of the National Science Centre in Poland through grant 2021/43/B/ST8/02895 for supporting the research.

REFERENCES

[1] P. Jenczyk., D.M. Jarząbek, Z. Lu, E.Gadalińska, N. Levintant-Zayonts, Y. Zhang, Unexpected crystallographic structure, phase transformation, and hardening behavior in the AlCoCrFeNiTi0.2 high-entropy alloy after high-dose nitrogen ion implantation, *Materials & Design*, Vol.216, pp.110568-1-11, 2022