Superalloy and Self-healing Ceramics for Turbine Applications

Keywords: Self-healing Ceramics, Ni-Co Base Superalloy, Turbine Blade, Disc, Jet Engine

Toshio Osada
Design and Producing Field / Superalloy and High Temperature Materials
OSADA.Toshio@nims.go.jp | https://samurai.nims.go.jp/profiles/osada_toshio?locale=ja

Background

Development of next-generation high-temperature materials is key to realize a low-carbon society. We believe that "self-healing ceramics" and "Ni-Co base superalloys" will be attractive candidates for turbine blade and disc materials, which can realize a ultra-high efficient aero space engine with light weight and without cooling.

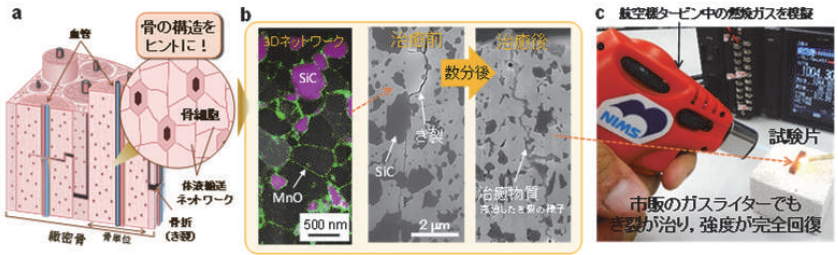
Aim

- Challenge to improved brittleness of ceramics using self-healing function like 'human bone'.
- Challenge to modeling for damage and self-healing in ceramics in actual turbine environment.
- Mechanism for strengthening and deformation in Ni-Co base superalloy developed by NIMS
- Promoting the Disc application of Ni-Co base superalloy using prediction of performance.

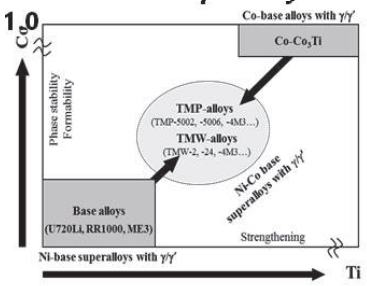
Advanced Research Topics

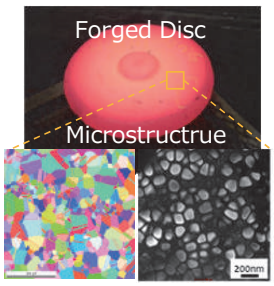
■Development of self-crack-healing ceramics capable of quick full strength recovery

—Bone-Healing Inspired Ceramics Shows Potential as an Aircraft Engine Material Capable of crack-healing during Flight—

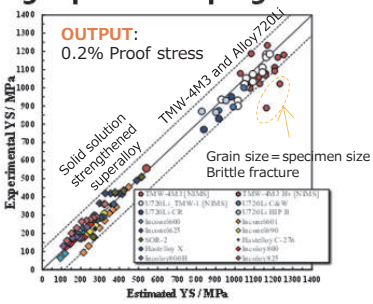


■Ni-Co base superalloy for turbine disc





■ Strength prediction program ver.



Publications

- T. Osada et al, Scientific Reports. 7 (2017) 17853-1
- S. Ozaki, T. Osada et al. Journal of the American Ceramic Society, 101 (2018) 3191
- T. Osada et al., Acta Materialia, 61, (2013) 1820-1829

Applied area and future prospects

- Self-healing ceramics will be am attractive candidate for turbine blade in jet engine.
- Latest TMW alloys and TMP alloy expected to be used as turbine disc for land base and jet engine.

Issues for technology transfer

- Increment of fracture toughness of self-healing ceramics must be important.
- Collaboration with computational simulation.
- Construction of database to accelerate their applications