PRIORITIZED THEME／TECHNOLOGY THEME

Materials Technology for Thermal Power Generation toward Carbon Neutrality

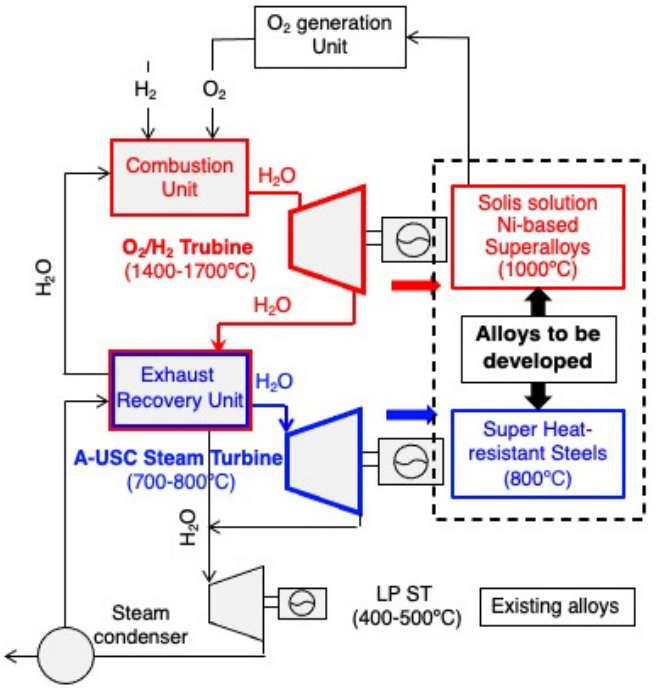
Project Leader : MASAO TAKEYAMA
Specially Appointed Professor, School of Materials and Chemical Technology, Tokyo Institute of Technology

R&D Team : Collaborative organization : Shimane University, Corporative organizations : JSW M&E, Hitachi Metals, Daido Steel, Nippon Steel, Toshiba Energy, KHI, MHI

Summary :

In order to achieve carbon neutrality in 2050, a novel thermal power generation plant with higher thermal efficiency (>70%), which also endures a stable supply of energy with no CO_2 emission, has to be realized. That is the Oxygen/Hydrogen Combustion Turbine generation system combined with an advanced ultra-super critical steam turbine system with steam temperature higher than 700°C. The key issue to make this plant not a castle in the sky is in the materials development strong enough for the high-temperature operation (see right figure).

In this project, we build up the microstructure design principles of novel Ni-based superalloys for the O_2/H_2 combustion turbine/the exhaust recovery units, and iron-based supersteels for the steam turbine units, with creep strength high enough to meet the long-term high temperature operation conditions, based on metallurgical disciplines of thermodynamics, kinetics, deformation and calculation science. Since we also put the carbon recycle technologies of supercritical CO_2 cycle power generation, together with the geothermal power generation, toward the carbon neutrality in this study, the degradation mechanisms of the materials under the severe environments will also be covered.



A combined oxygen/hydrogen combustion turbine generation system and the materials to be developed.