High-Temperature Superalloys

Cobalt-based High-Temperature Superalloys

Prof. Emeritus Kiyohito ISHIDA, Prof. Ryosuke KAINUMA
Prof. Toshihiro OMORI et al.(Tohoku University)

1. Background

- At power plants and aircraft industry, the thermal efficiency increases with increasing operation temperature. Therefore, the superalloys, which can resist high-temperatures, are strongly required.
- Both high manufacturability and high workability are demanded at the same time.
- In some applications, the wear resistance at high temperatures is also required.

2. Enhanced Creep Resistance of a New Co-Al-W Alloy

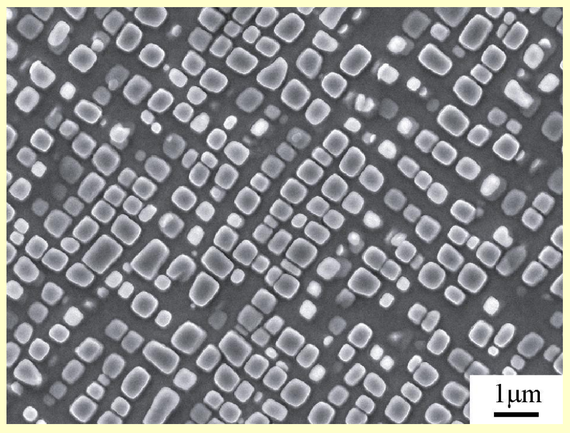
● Co-based alloys' properties as superalloys candidate (compared to Ni-based superalloys)
1) Higher melting point ･･･favorable
2) Lower strength ････ ･･･unfavorable

Precipitation hardening of matrix by ordered phase as in the case of Ni-based superalloys is necessary.

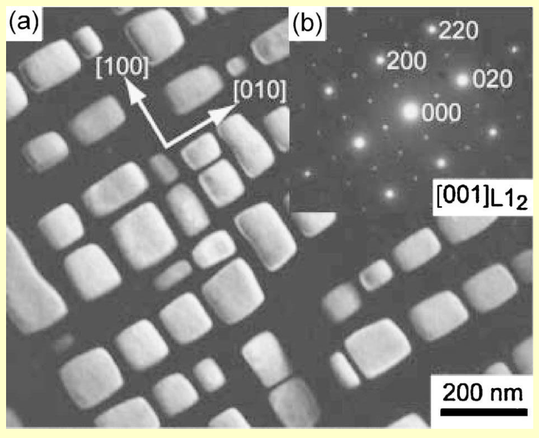
● γ＋γ' phase in Co-Al-W was discovered

Base Element	Melting Point (K)	Superalloys	Crystal Structure of Superalloys	
Nickel (Ni)	1,728	Ni-Al-Ti	matrix	γ(FCC)
			Ordered phase	γ'(Ni_3(Al,Ti) with $L1_2$ structure)
Cobalt (Co)	1,768	Co-Al-W (this study)	matrix	γ(FCC)
			Ordered phase	γ'(Co_3(Al,W) with $L1_2$ structure)

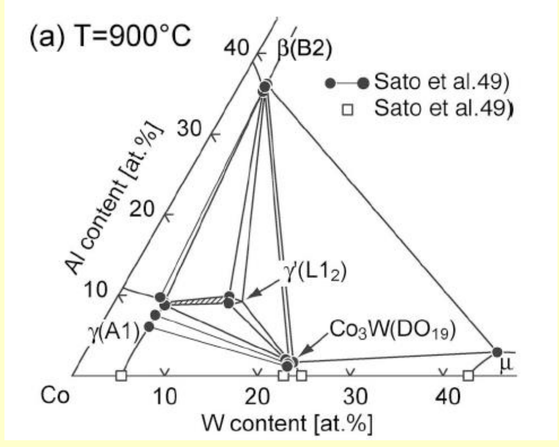
Co-Al-W superalloys



Phase of Newly developed Co-Al-W alloys

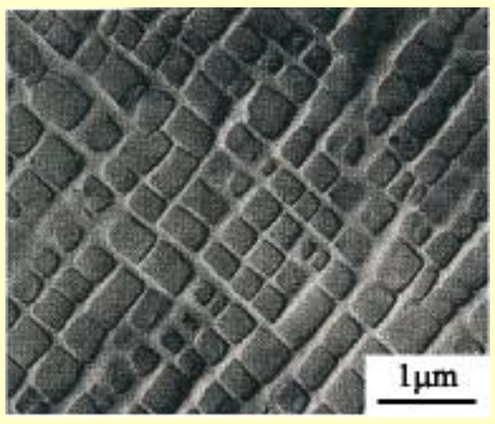


Precipitated phase was confirmed as γ' phase



Phase diagrams of the Co-Al-W ternary system

Ni-based superalloys



γ＋γ' phase in Ni-based superalloys for comparison

3. Prospective Applications

- The **Wrought Alloys** by this technology, which has high creep resistance, are expected to be used widely i.e. turbine engine components, auto parts.
- The **Cast Alloys** by this technology, which also resist abrasions, are expected to be used at several machining fields i.e. FSW tool.

Wrought Alloys: application examples

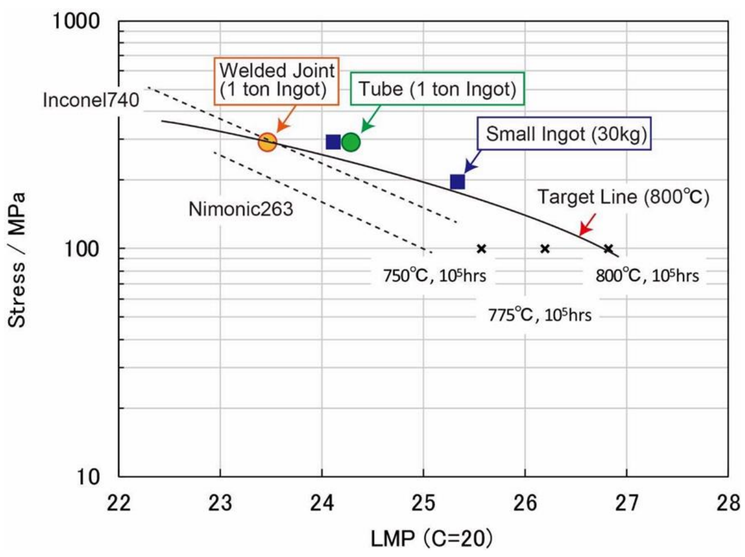


Fig.1 Creep Resistance Characteristics of A-USC(Advanced Ultra Super Critical) power generation material

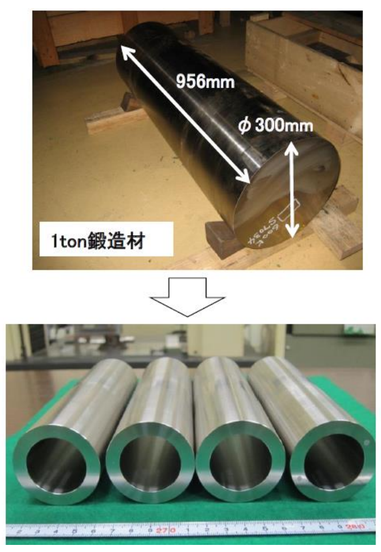


Fig.2 Boiler Tube made of A-USC power generation material

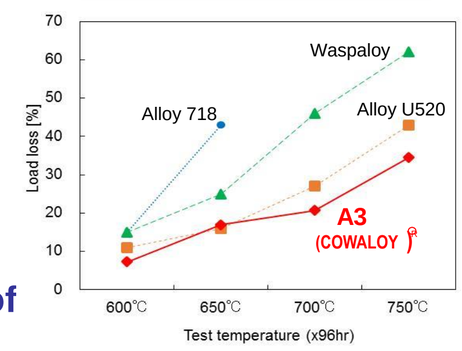


Fig.3 COWALOY® springs

Cast Alloys: application examples

Fig.4 Welded Sample
(Two Ti plates are welded)

4. Patent Licensing Available

Patent No.: WO2007/032293, WO2007/091576 Patent Family

(Contact) JST/ IP Management and Licensing Group
Phone: +81(Japan)-3-5214-8486 E-mail: license@jst.go.jp