Complete Technological Service - Forming, Heat Treatment

RECRYSTALLIZATION **BEHAVIOR OF NICKEL BASED** SUPERALLOY

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Thermomechanical processing – microstructure evolution

ABSTRACT

The thermomechanical processing of nickel base superalloy is the way to considerably influence the grain size. As uniform coarse grain size increases the creep strength and crack growth resistance. In the work, the processing to achieve uniform recrystallized grain structure with variation of thermomechanical parameters is investigated.

The MoNiCr alloy is determined for modern conceptions of nuclear reactors in which molten fluoride salts are used in the primary and/or secondary circuit as coolants. It represents a material alternative with high corrosion resistance in the area of fluoride salts and it has very good creep properties in the temperature range of 650 – 750 °C as well. The manufacture of vessels and fittings from MoNiCr alloy requires managing the technology of forming of this high-alloyed material. The key moment seems to be forming of cast state of the material to the state of cast recrystallized microstructure with a homogenous fine grain. Particular stress condition is besides temperature very important at hot forming. Nickel alloys are able to accept a significantly higher deformation level if compression stress prevails.

Samples were subjected to loading with cycles of tensile and compression deformation. The amount of deformation was increased in steps. It is evident that increasing of deformation led to increase of recrystallized volume of grains. At lower deformation recrystallization occurs only on the boundaries of casting grains, with higher deformation it extends into the grains

Chemical composition of experimental alloy									
Element	Mo	Cr	Ti	Fe	Mn	Nb	Al	W	Ni
Wt. %	15.81	6.82	0.03	2.32	0.04	0.01	0.26	0.06	base



Deformation cycles applied on particular samples





Cold working of samples prior hot deformation

Hot deformation applied: 0,3





Hot deformation applied: 0,7





Hot deformation applied: 1,1



- It was found, that minimal deformation level for starting the recrystallization during the hot working is Φ≈2.5. Only such high strain level ensures the recrystallization within the cast grains.
- The recrystallization process is significantly accelerated by preceded cold forming. The structure after cold deformation Φ≈0.25 followed by $\Phi \approx 1.1$ hot deformation was perfectly recrystallized.

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