

자동차 부품용 저탄소 크롬강재의 제어단조

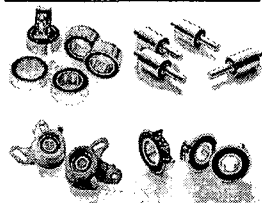
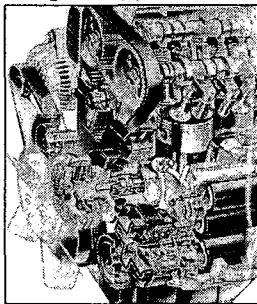
June 18, 2004

이 재성, 송 복한, 박 창남

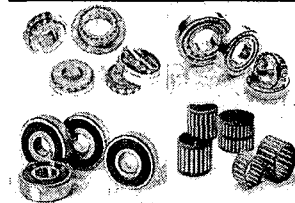
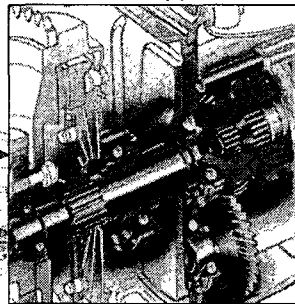
FAG Bearings Korea
R&D Center

연구 배경

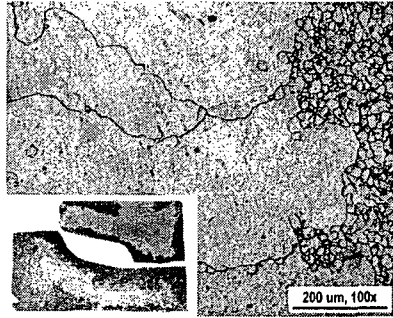
Engine Applications



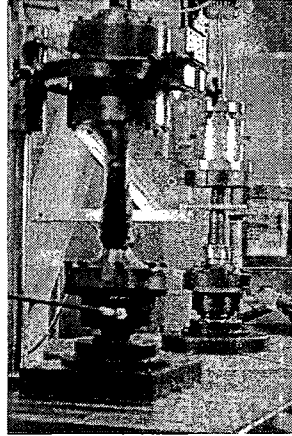
Powertrain Applications



**Abnormal Grain Growth [AGG]
by Secondary Grain Growth [SGG]**



※ SCr420H (corresponding SAE5120H)



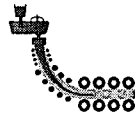
베어링 부품 생산공정



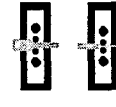
Melting



Degassing



C.Casting



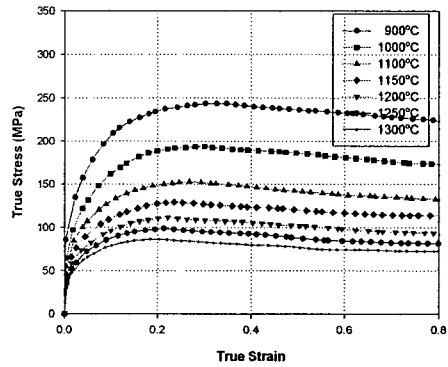
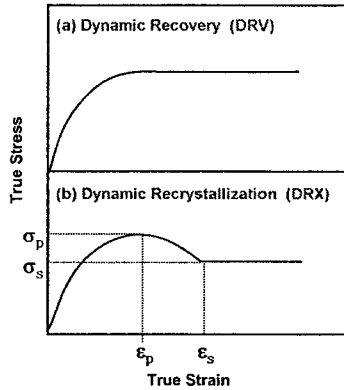
Hot Rolling



고온 변형 거동 조사



※ 고온 압축

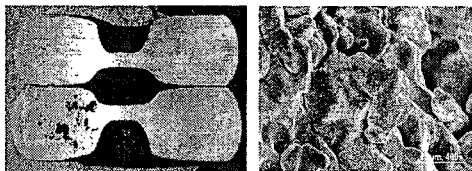
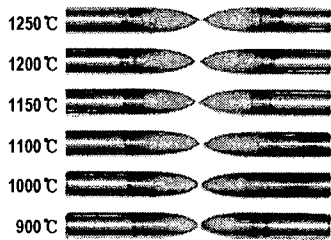


Stress-Strain Curve at High Temperature

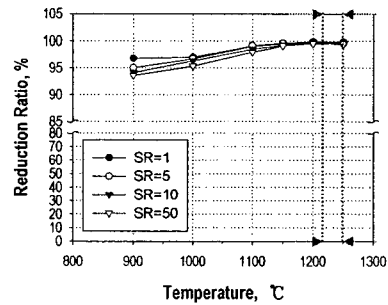
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Technology platform Hot Forging
Schweinfurt, 28./29.04.2004

※ 고온 인장



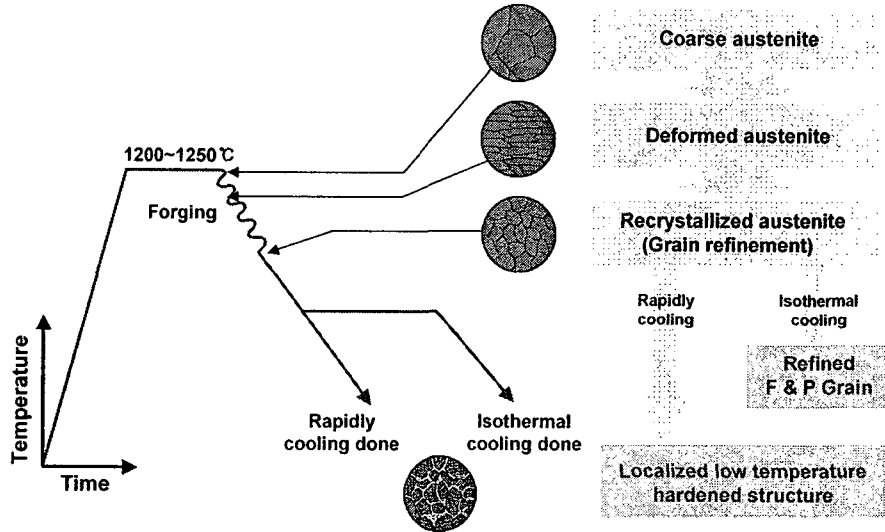
Optimum Forging Temp. 1220~1250°C



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단조 공정 설계



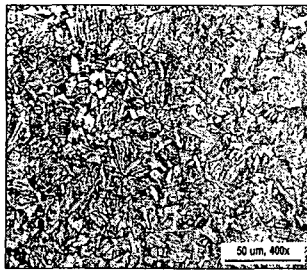
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Technology platform Hot Forging
Schweinfurt, 28./29.04.2004

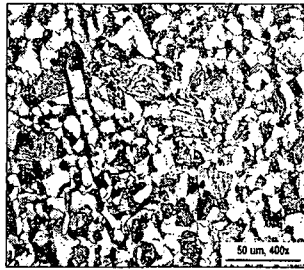
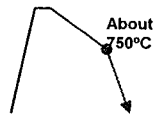
단조 후 냉각공정



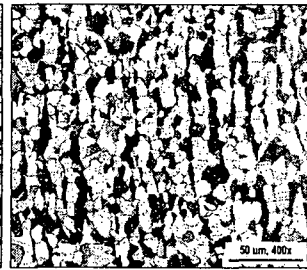
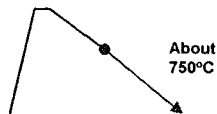
※ Microstructure



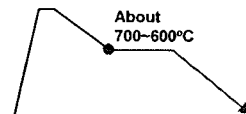
Cooling done by ventilator



Natural air cooling



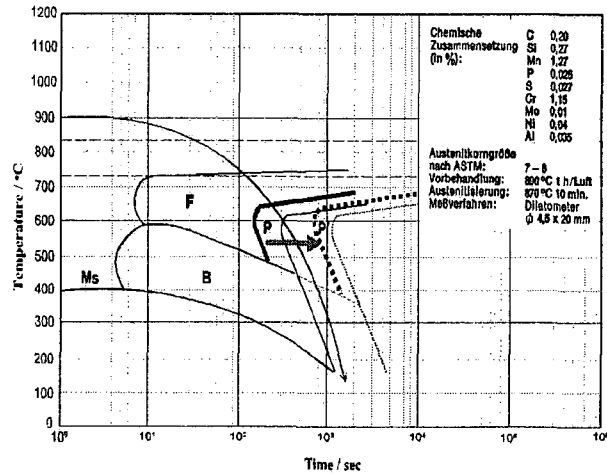
Isothermal cooling



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※ Appearance of Bainitic Structure [CCT diagram]



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※ Effect of Isothermal Holding Temperature on Grain Growth Behavior

	a) 550 °C x 1hrs.	b) 680 °C x 1hrs.	c) 700 °C x 1hrs.
Ventilator cooling			
Natural air cooling			
Isothermal cooling			

After 1200 °C forging and 930 °C x 5hrs Carburizing

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※ Cause of AGG in poly-crystalline

Precipitation Pining Effect: Coarsening of PPT with rare density
 Solute Drag Effect: Local decrease in GB Solute Segregation

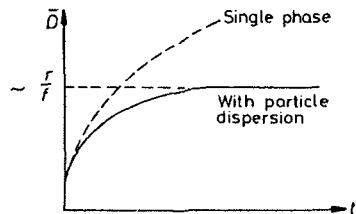
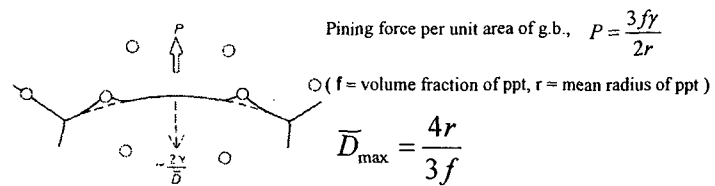
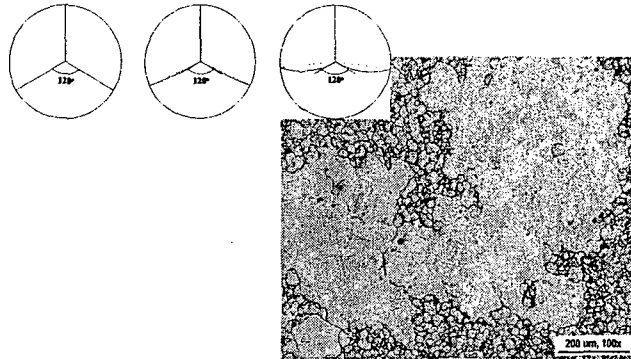
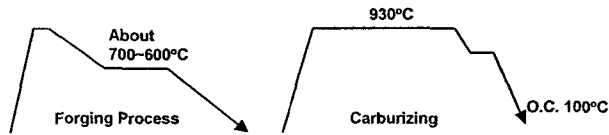
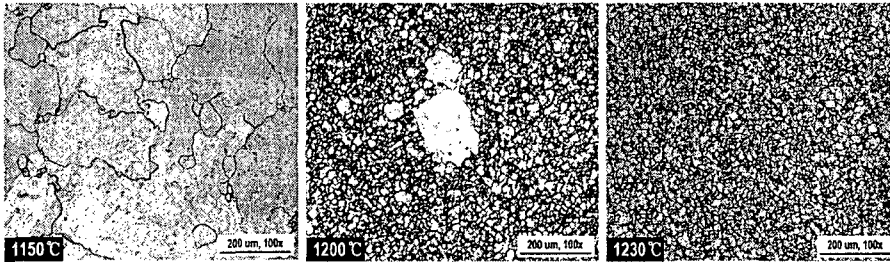


Fig. 3.31 Effect of second-phase particles on grain growth.

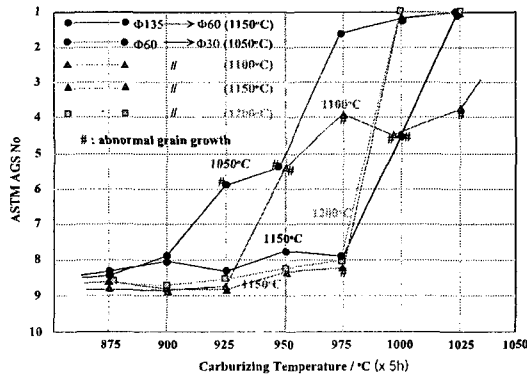
※ 최고 가열온도별 결정립 거동



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※ 최고 가열온도별 결정립 거동

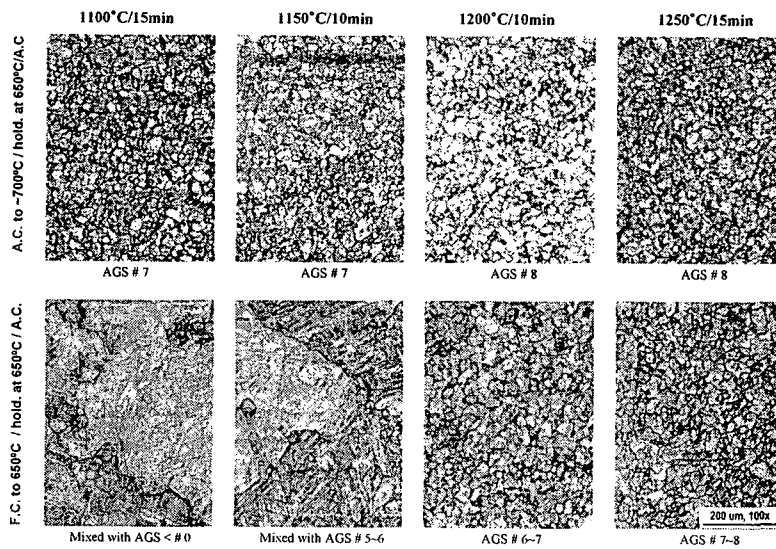
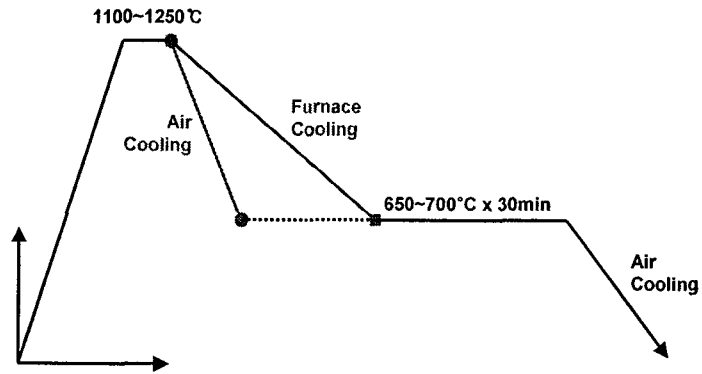


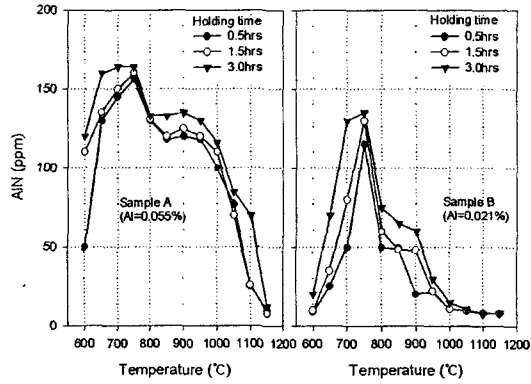
Effect of forging temperature on the grain growth behavior; 0.025 Al, N 96 ppm steel (Sanyo report).

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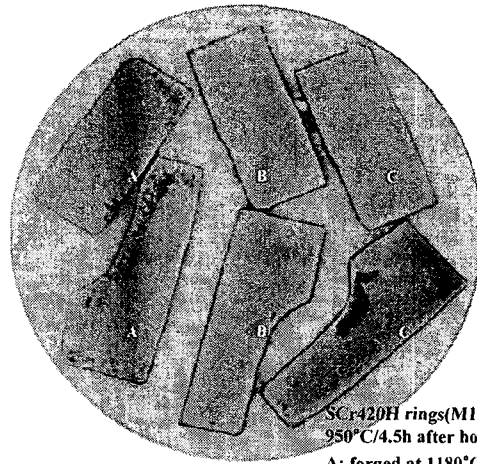
※ Effect of Cooling Speed on Grain Growth Behavior





A mount of AIN in steels isothermally held at various temperatures on cooling from solution treatment of 1200 °C

A : 0.0067% N, 0.055%Al
 B : 0.0083% N, 0.021%Al



SCr420H rings(M12649) carburized at 950 °C/4.5h after hot forging:

A: forged at 1180 °C and F.C. at 650 °C
 B: forged at 1230 °C and F.C. at 650 °C
 C: forged at 1230 °C and A.C.

1. Consideration for specifications of wheel bearings.
2. Development of SAE1055 for the mass production
3. SAE1055 modification
by Micro-alloying elements addition