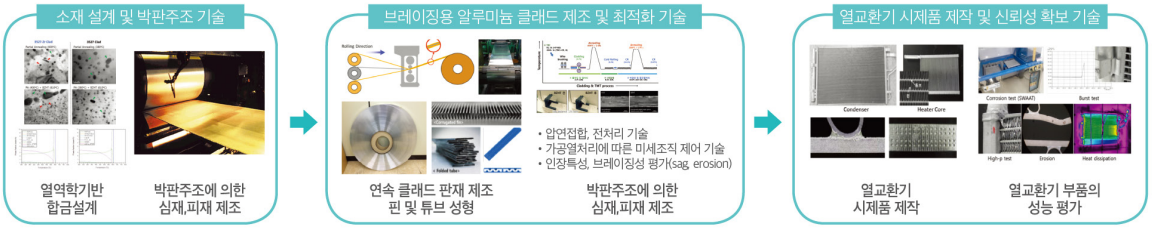
자동차 열교환기용 알루미늄 클래드 제조 기술

Aluminum Clad Sheets for Automotive Heat Exchangers

TRL5

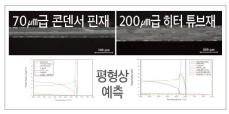
기술내용

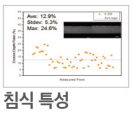
- 미래형 자동차 대응 열교환기용 알루미늄 클래드 소재 제조
- 알루미늄 복합판재 제조기술로서 다층화 기술, 다층판재 압연기술, 고기능화 기술 등을 개발
- 자동차, 에어컨 등에 적용 가능한 브레이징용 알루미늄 클래드 판재 제조기술 확립



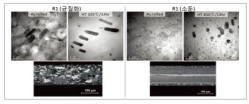
브레이징용 고성능 박육 클래드 제조 및 열교환기 부품 신뢰성 향상

- 자동차 열교환기 브레이징용 고강도 알루미늄 클래드 개발
  - 저비용 공정(박판연속주조, 압연접합) 적용
  - 생성상/미세조직 제어를 통한 강도 및 브레이징성 향상
- 클래드재 고성능화 및 박육화를 위한 고강도 심재 설계
  - 콘덴서 핀용 70㎛급, 히터 튜브용 200㎛급
  - 평형상 분율 예측 및 박판주조 공정 최적화
- 클래딩 및 압연 공정 최적화
- 브레이징성 향상 기술
- 열교환기 시작품 성능 및 신뢰성평가

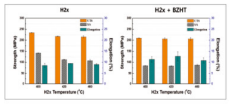




침식 특성



열처리에 따른 석출상 및 결정립 형상 변화 (TEM, OM)



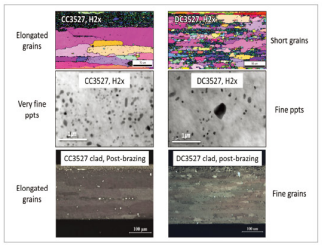
새그 특성

- 브레이징 후 인장강도 200MPa, erosion 20%급 히터 튜브용 클래드 판재 제조기술 확보
- 브레이징 후 인장강도 160MPa, sag distance 26mm급 콘덴서 핀용 클래드 판재 제조기술 확보

우수성

- 연속주조기술 (기존 기술 : DC 주조)
  - 박판주조에 의한 다양한 합금의 저비용 제조가능, 빠른 냉각속도로 2차상 미세화
- 압연접합기술 (기존 기술 : Slab-to Slab 접합)
  - Coil-to-Coil 상온압연접합 공정으로 공정 비용 절감 가능
- 조직제어기술
  - 합금설계에 따른 생성상 예측 및 제어
  - 가공열처리 제어에 의한 최적 미세조직 도출

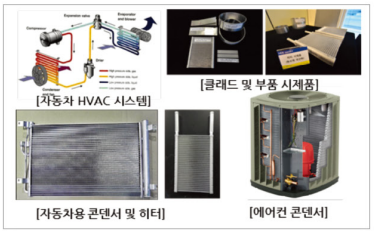
- **[특허] KR10-1401080 브레이징용 Al-Si 합금 박판 및 이의 제조 방법**



미세조직
(박판주조 VS DC주도)

사업성

- 국내 자동차 열교환기 알루미늄 클래드 판재 시장은 약 2000억원 규모로 판재 국산화에 따른 수입 대체 효과
  - 자동차용 히터, 콘덴서, 오일쿨러 등 열교환기, 가전용 에어컨 등에 이용 가능
  - 국산화 개발 이슈에 따른 수입 알루미늄 클래드 판재의 가격 하락
  - 경량 고성능 열교환기의 각종 브레이징용 알루미늄 클래드 판재 제조기술로 활용
- 완성차 업체의 수요 요구 및 적용 분야 확대 가능
  - 외산대비 제조 단가 가격경쟁력 확보 가능 (원료비, 가공비 등을 고려한 원가 산출)



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Aluminum Clad Sheets for Automotive Heat Exchangers

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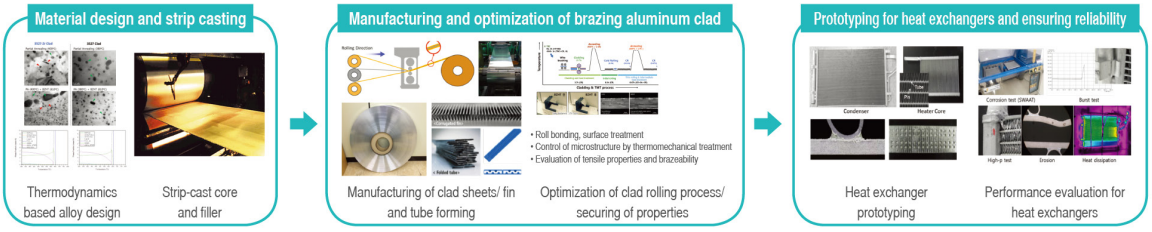
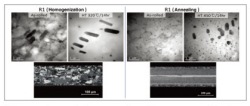
Technology Overview

- Aluminum clad sheets for heat exchangers to be used in futuristic automotives
- Ability to make multi-layered aluminum sheets, roll multi-layered sheets and give advanced functionality to the sheets
- Aluminum clad sheets for brazing, applicable to automotives, air conditioners, and more

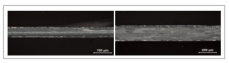


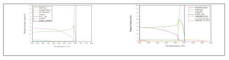
Manufacturing high performance, thin-walled clad for brazing and improving reliability of heat exchanger components

- High-strength aluminum clad sheets for automotive heat exchangers
  - Based on low cost process (strip casting, cold-roll bonding)
  - Higher strength and better brazeability through microstructural control
- High-strength core alloys for clad sheets with high performance and thin gauges
  - 70μm thickness for condenser fins; 200μm thickness for heater tubes
  - Prediction of equilibrium phase fraction and optimization of strip casting process
- Optimization of cladding and rolling
- Enhanced brazeability
- Evaluation of performance and reliability of heat exchangers

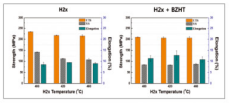


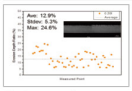
Change in precipitates and grain structure after heat treatment (TEM, OM)





Prediction of equilibrium phase





Erosion property

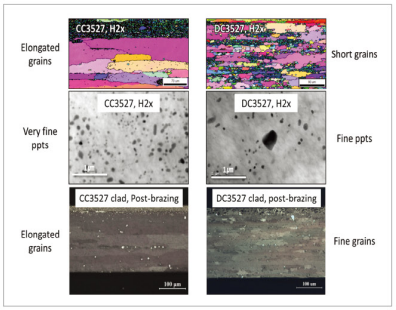
Sag property

- **Clad sheets for heater tubes having post-brazing tensile strength of 200 MPa and 20% less erosion**
- **Clad sheets for condenser fins having post-brazing tensile strength of 160 MPa and sag distance of 26 mm**

Highlights and Strengths

- Continuous casting (existing technology: DC casting)
  - Low-cost manufacturing of different alloys based on strip casting; refinement of secondary phases by high cooling speed
- Cold-roll bonding (existing technology: slab-to-slab welding and cladding)
  - Cost-effective owing to coil-to-coil roll bonding at room temperature
- Microstructure control
  - Alloy design with prediction and control of phase formation
  - Optimization of microstructure based on thermomechanical treatment

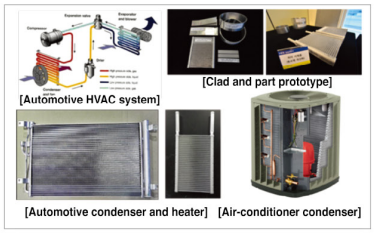
- **[Patent] KR10-1401080 A STRIP-CAST ALUMINUM-SILICON ALLOY FOR BRAZING AND MANUFACTURING METHOD OF THE SAME**



Microstructure (strip casting vs. DC casting)

Business Cases

- 200 billion KRW market in Korean automotive aluminum clad sheets
  (Replaceable for the previously-imported clad sheets)
  - Potential applications to automotive heaters, condensers, coil coolers, and home air conditioners.
  - Price-down of the imported clad sheets through domestic development of clad sheets
  - Applicable to make aluminum clad sheets for brazing used in lightweight, high performance heat exchangers
- Needs of automakers and expandable applications to other areas.
  - Lower cost than imported competitors' to give price competitiveness (in terms of material cost, processing cost, etc)



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