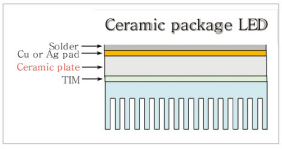
고출력 전자패키지용 고열전도 질화알루미늄 후막소재

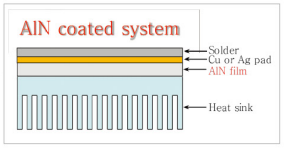
Thermally Conductive AlN Thick Films for High Power Electronic Packages TRL5

기술내용

- 전자부품의 경박단소, 고집적화에 따른 열밀도 증가가 소자의 기능 저하, 수명 단축, 신뢰성 감소 초래
  ⇨ 전자패키지의 방열문제가 핵심기술로 부상.
- 종래 고출력 전자패키지에서는 고열전도 세라믹 기판소재가 주로 사용
  ⇨ 기판소재와 방열판을 연결하는 저열전도의 열계면소재 사용 불가피
- 금속 방열판 표면에 고열전도 AlN 세라믹 후막소재 제조 기술 개발
  ⇨ 열계면소재 불필요, 얇은 패키지 구조, 열저항 감소 등의 장점

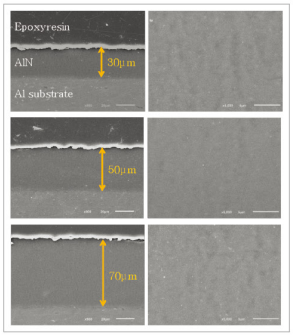


종래 세라믹기판 패키지

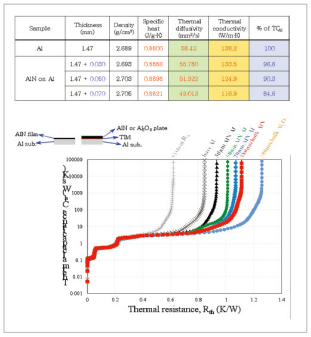


AlN 후막 패키지

고순도 AlN 후막 제조

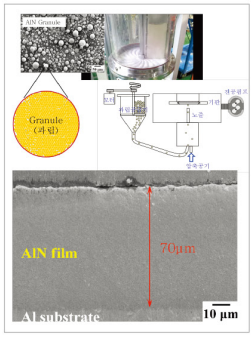


30, 50, 70μm thick
pure AlN films on Al

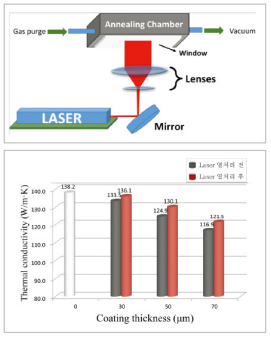


열전도도 및 열저항 평가

AlN 후막 두께 증가 기술 및 후열처리 기술



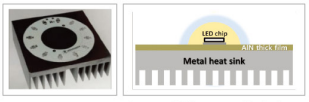
AlN 막 두께 증가(GSV 공정)



레이저 열처리 통한 열전도도 향상

우수성

- GSV(Granule Spray in Vacuum) 공정을 이용하여 기존 고온 공정에서는 불가능했던 최대 70μm 두께를 가지는 고내전압 고순도 AlN 후막 코팅층 제조
- 저열전도도의 열계면소재 배제가 가능하므로 열저항 감소 통한 열방출 극대화 가능 ⇨ AlN 코팅 시편의 열저항이 기존 COB(Chip on board) 타입 LED 패키지의 절반 수준
- Laser annealing 장비를 이용한 AlN 코팅층의 선택적 열처리 및 이를 통한 열전도도 향상
- COH(Chip on heatsink), 전력반도체 등의 다양한 전기전자 패키지의 절연층 제조에 사용 가능



COH 타입 LED 패키지

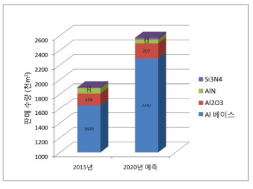
- **[특허] KR10-1735822 후막 형성용 질화물 분말, 이를 이용한 질화물 후막 제조방법 및 이에 의해 제조된 후막**

사업성

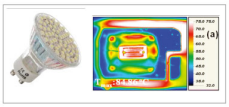
방열 기판 세계 시장 규모

	2015년	2020년(예측)
Al 베이스 회로기판	1,639	2,287
Al_2O_3 회로기판	170	207
AlN 회로기판	73	53
Si_3N_4 회로기판	13	24
합계	1,894	2,571

출처 세계 방열부재시장의 현상과 장래전망 [야노경제연구소, 2016]



활용분야



LED 조명

전력반도체

전기자동차

이전 가능 기술

- 고열전도 세라믹 후막 제조 기술
- 고내전압 세라믹 절연 후막 제조 기술

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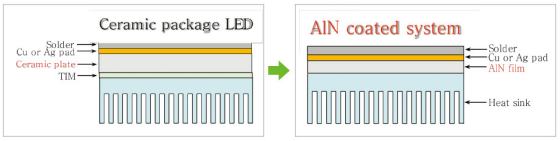
Thermally Conductive AlN Thick Films for High Power Electronic Packages

TRL5

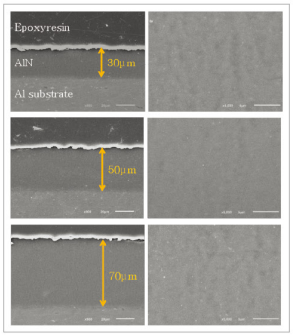
Technology Overview



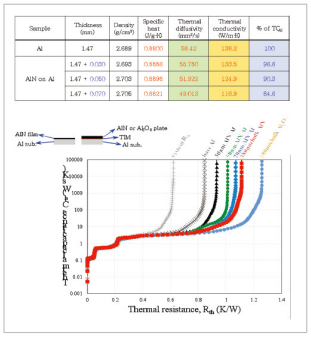
Existing ceramic substrate package | AlN thick film package

- Increasingly lighter, thinner, shorter and smaller electronic parts lead to higher heat density that, in turn, lower elements' functionality, shorten their lives and undermine their reliability.
  ⇨ The key to address these problems is to ensure that heat is properly released from electronic packages.
- Existing high power electronic packages use highly thermal conductive ceramic substrates.
  ⇨ This necessitates use of low thermal conductive, thermal interface material to connect the substrate and heat sink.
- This technology pertains to applying thermally conductive AlN thick films to the surface of metal heat sink
  ⇨ No thermal interface material required; thin package; less thermal resistance

Fabricating highly pure AlN thick films

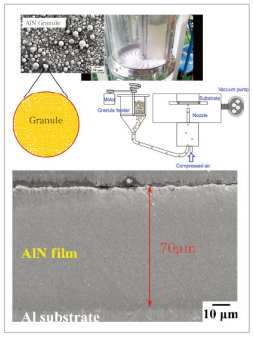


30, 50, 70μm thick pure AlN films on Al

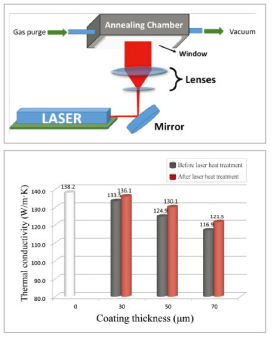


Evaluation of thermal conductivity and thermal resistance

Thicker AlN thick films and post-heat treatment



Greater AlN film thickness (GSV process)

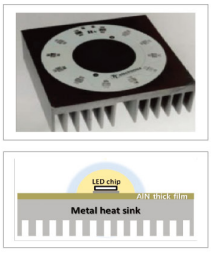


Higher thermal conductivity through laser heat treatment

Highlights and Strengths

- Possible to fabricate highly breakdown voltage, highly pure AlN thick films having the thickness of up to 70 μm using GSV, which would not have been possible with the existing high temperature process.
- Possible to maximize heat releasing via reduced thermal resistance because no thermal interface material is required.
  ⇨ The thermal resistance of AlN coated specimen is only half of the existing COB type LED packages'.
- Selective heat treatment of AlN coated layers using laser annealing equipment and higher thermal conductivity
- Applicable to fabrication of diverse electric or electronic packages including COHs and power semiconductors

- **[Patent] KR10-1735822 NITRIDE POWDER USED FOR PREPARING THICK FILM, METHOD FOR PREPARING NITRIDE THICK FILM USING THE POWDER AND THICK FILM PREPARED THEREBY**



COH type LED packages

Business Cases

Global market for heat sinks

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Al base circuit board	1,639	2,287
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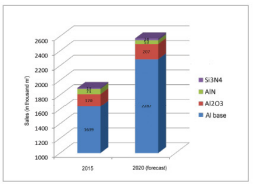
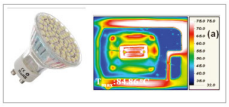


Source: Prospects for global heat sink market: today and tomorrow (Yano Economic Research Institute, 2016)

Benefits



LED lighting

Power semiconductors

Electric vehicles

Transferable technology

- Technology to fabricate thermally conductive ceramic thick films
- Technology to fabricate highly breakdown voltage ceramic thick films

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