

알루미늄 분말 표면 코팅 기술

Synthesis of Surface-Coated Aluminium Powders

TRL7

기술내용

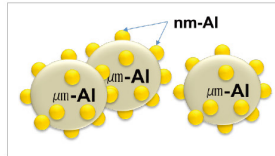
- 산소와 결합시 높은 폭발성과 반응성을 보이는 알루미늄(Al)계 금속분말 취급 안정성 확보 기술
- 알루미늄 분말 표면 산화막을 제거하여 반응성을 증가시키기 위한 유기물 및 무기물 코팅 기술
- 고반응성의 알루미늄 분말 국방 및 민수용 응용기술

Plasma-Reactor



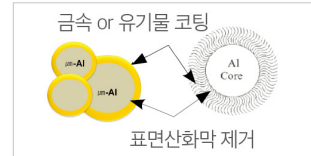
분위기 제어
(Carrier gas 산소농도 제어) 산소/Ar혼합가스 사용

신규 Al 분말 제조기술



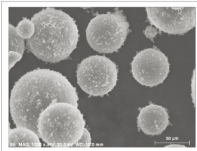
NAP
(Nanoparticle-Attached Powders)

Al 분말 산화막 제거 및 코팅기술

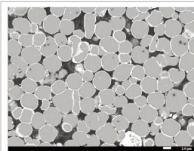


- Al의 높은 반응성을 이용하기 위한 Al분말 형상 설계 기술 개발 : NAP분말소재 제조공정기술 및 분말 합성
- 낮은 점화 온도와 높은 반응성 및 취급안정성을 동시에 확보한 유/무기 코팅된 알루미늄 분말 기술 국산화 실현

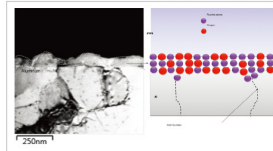
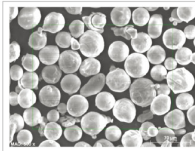
신규 Al분말



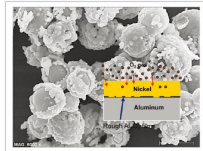
금속코팅 Al분말



유기물 코팅 Al분말



금속코팅 극미세 Al분말



- 알루미늄 분말의 표면 산화막 제거와 재산화 방지 기술 연구

우수성

- 마이크로 알루미늄 분말 표면 코팅기술 확보로 고반응성 분말기술 국산화 성공
 - 100nm급 유기물 코팅된 알루미늄 분말 국산화 (지적재산권 확보) : 플루오르화 소재 및 니켈 기술 이용
 - 수백 nm급 금속 코팅된 알루미늄 분말 국산화
- 신개념 계면 구조를 도입하여 취급이 어려운 순수한 알루미늄 분말의 취급안정성 확보기술 개발
 - 국방용 소재로 개발시 사용가능한 수준의 독자기술의 확보
 - 용액중 알루미늄 분말 산화막 제거 기술 확보
 - 점화/연소/폭발 특성평가 기술 자체 확보

- [특허] KR10-2016-0133712 불소계 탄화수소 고분자층이 코팅된 알루미늄 분말 및 이의 제조방법

사업성

- 고반응성 알루미늄 분말의 경우 순수 Al분말 기준 시장규모가 CAGR3.2% 기준으로 2,800억원 규모로 집계되고 있으며, 국내 시장은 2016년 현재 196억 원 규모로 예측되고 있음
- 현재까지 국방용 소재 및 태양전지등 금속 페이스트 제조업체들과 용접 업체들이 순수 Al분말에 대한 점유율을 가졌으며, 향후에는 중국의 저가 Al분말 시장이 크게 확대될 것으로 예상됨

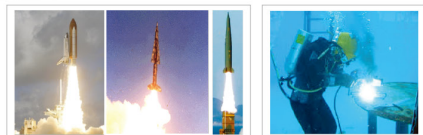
활용분야

- 태양전지 후면전극
- 고체로켓용 추진제
- 국방무기용 탄두소재
- 수중 용접봉 소재

이전 가능 기술

- 알루미늄 분말 유기물 코팅 기술
- 알루미늄 분말 금속 코팅 기술
- 알루미늄 분말 표면 산화막 제거기술

기대효과



우주선 발사체용
고체연료/액체연료 첨가제

수중 접합소재

Synthesis of Surface-Coated Aluminium Powders

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Technology Overview

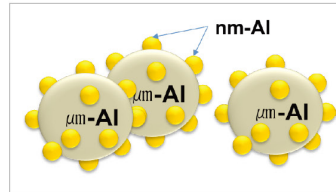
- This technology ensures stability during handling of aluminum (Al) base metal powder that is highly explosive and reactive when combined with oxygen.
- Spontaneous coating technology of organic and inorganic materials instead of surface oxide present at Al powder's surface.
- Synthesis of surface-coated Al powders for various military and civil applications

Plasma-Reactor



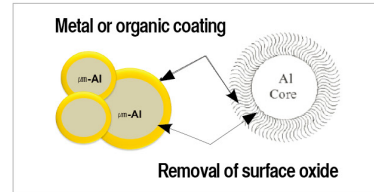
Atmosphere control (control of carrier gas's oxygen concentration), oxygen/Ar mixed gas used

Fabrication of new Al powder



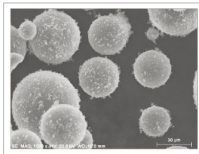
NAP (Nanoparticle-Attached Powders)

Coating of organic/inorganic materials instead of surface oxide

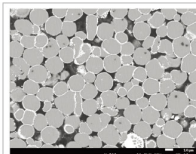


- Designing Al powder geometry to leverage Al's high reactivity: Fabrication of NAP powdered material and powder synthesis
- First in Korea to develop a technology to fabricate organically/inorganically coated Al powder with both low ignition temp, high reactivity and handling stability

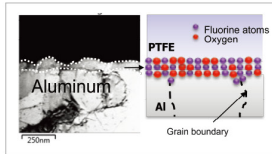
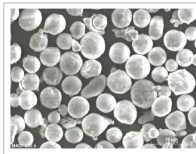
New Al powder



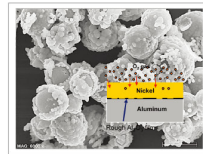
Metal coated Al powder



Organically coated Al powder



Metal coated ultra-fine Al powder



- Working on how to remove oxide from the surface of Al powder and to prevent re-oxidation

Highlights and Strengths

- Synthesis of surface-coated Aluminium Powders
 - Organically coated 100 nm level Al powder (IP protected) using fluorine or nickel
 - Al nanoparticle-attached micro-scale Al powders (NAP)
- Achievement of handling safety in Al powder using innovative interface structure
 - Reliable enough to be applied for military purposes
 - Possible to remove aluminum powder's oxide membrane in solution
 - Capable of evaluating ignition, combustion and explosive properties
- [Patent] KR10-2016-0133712 ALUMINUM PARTICLES COATED WITH FLUORINATED HYDROCARBON POLYMER LAYER AND METHOD OF MANUFACTURING THE SAME

Business Cases

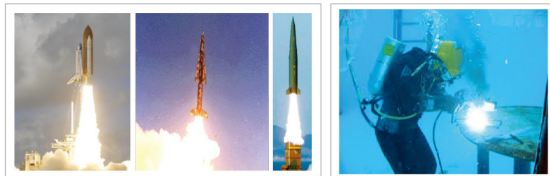
- The global market for highly active pure Al powder is worth 280 billion won (CAGR 3.2%). The local market is worth 19.6 billion won as of 2016.
- The market has been dominated by makers of metal paste (e.g. military purpose materials, solar cells). In the future, low-priced Al powder from Chinese vendors will expand market share.

Applicable products/services

- Rear electrodes of solar cells
- Boosters for rockets
- Warheads
- Underwater welding rods

Transferable technology

- Technology to organically coat Al powder
- Technology to metal-coat Al powder
- Technology to remove oxide membrane from Al powder's surface



Additives to solid and liquid fuel for space projectiles

Underwater bond