항공우주 및 기계공학과

1. 연구실(실험실): 다기능 복합재료 및 제조 연구실
(Multifunctional Composites and Manufacturing Lab, MCML)

장소: 연구동 105호　　홈페이지: mcml.kau.ac.kr

2. 담당 교수

성 명	전공분야	연락처	메일주소
남영우	항공우주구조 및 복합재료	02-300-0121	ywnam@kau.ac.kr

3. 연구분야
- 스텔스/레이돔 복합재 구조
- 극초음속 고내열 세라믹 복합재 구조
- 3D 프린팅 기능성 복합재 구조
- 우주환경, 위성 및 ISRU(In-Situ Resource Utilization) 우주 복합재 구조 공정 기술
- 열가소성 복합재료 구조 설계/해석/공정/제작/평가, 용접 기술
- Lightning Strike/Superhydropobic/Electrothemal-Heating 기능성 복합재료 구조
- 복합재료 구조 설계/해석/제작/공정/평가

4. 연구생 모집
- 모집 시기: 상시모집
- 학부 연구생 0명
- 석사과정 0명
- 박사과정 0명

5. 연구실 특장점
- 국내외 항공우주·복합재료 분야 최고 권위 학술대회 참가 및 주요 학술지 학술활동 참여 기회 제공
- 복합재료 연구의 소재-설계-해석-제작-검증 및 평가 전 주기 경험
- 대한항공, 한국항공우주산업, 한화에어로스페이스, LIG D&A 등 방산 기업들과 협업, 과제 참여 기회

6. 최근 졸업생 취업 현황
- 현대자동차 R&D Center(남양), 한국항공우주산업(KAI), LG전자, 한국재료연구원, 한화에어로스페이스, LS ELECTRIC, 한화시스템, 쎄트렉아이, 한국전자기술연구원, 국방기술진흥연구소, 한국산업기술시험원, 현대자동차, 파동에너지극한제어연구단, 경남테크노파크, AP위성, ANH Structures, 캐드아이티코리아, 국방과학연구소, ㈜아스트 등

7. 수상 내역(최근 4년)
- 2026 항공우주시스템공학회 전국 대학생 캡스톤디자인 경진대회 LIG D&A상(김주호, 오채린, 강소은 연구원)
- 2026 한국복합재료학회 춘계학술대회 복합재료 우수논문상(서한준 연구원)
- 2026 한국복합재료학회 춘계학술대회 복합재료 우수논문상(이건규 연구원)
- 2026 BK21 지속가능 초저궤도 우주서비스 인재양성 사업단 최우수논문상(홍동준 연구원)
- 2025 The 3rd C-K-J Joint Symposium on Composite Materials Best Paper Award(서한준 연구원)
- 2025 항공우주시스템공학회 전국 대학생 캡스톤디자인 경진대회 장려상(임은섭, 김태완, 박소영 연구원)
- 2025 항공우주시스템공학회 전국 대학생 캡스톤디자인 경진대회 장려상(이한철, 조운성 연구원)
- 2025 한국항공우주학회 학부생 논문 경진대회 최우수상(임영빈, 이한철 연구원)
- 2025 한국항공우주학회 학부생 논문 경진대회 준우수상(임은섭 연구원)
- 2025 한국복합재료학회 춘계학술대회 우수 논문상(서한준 연구원)

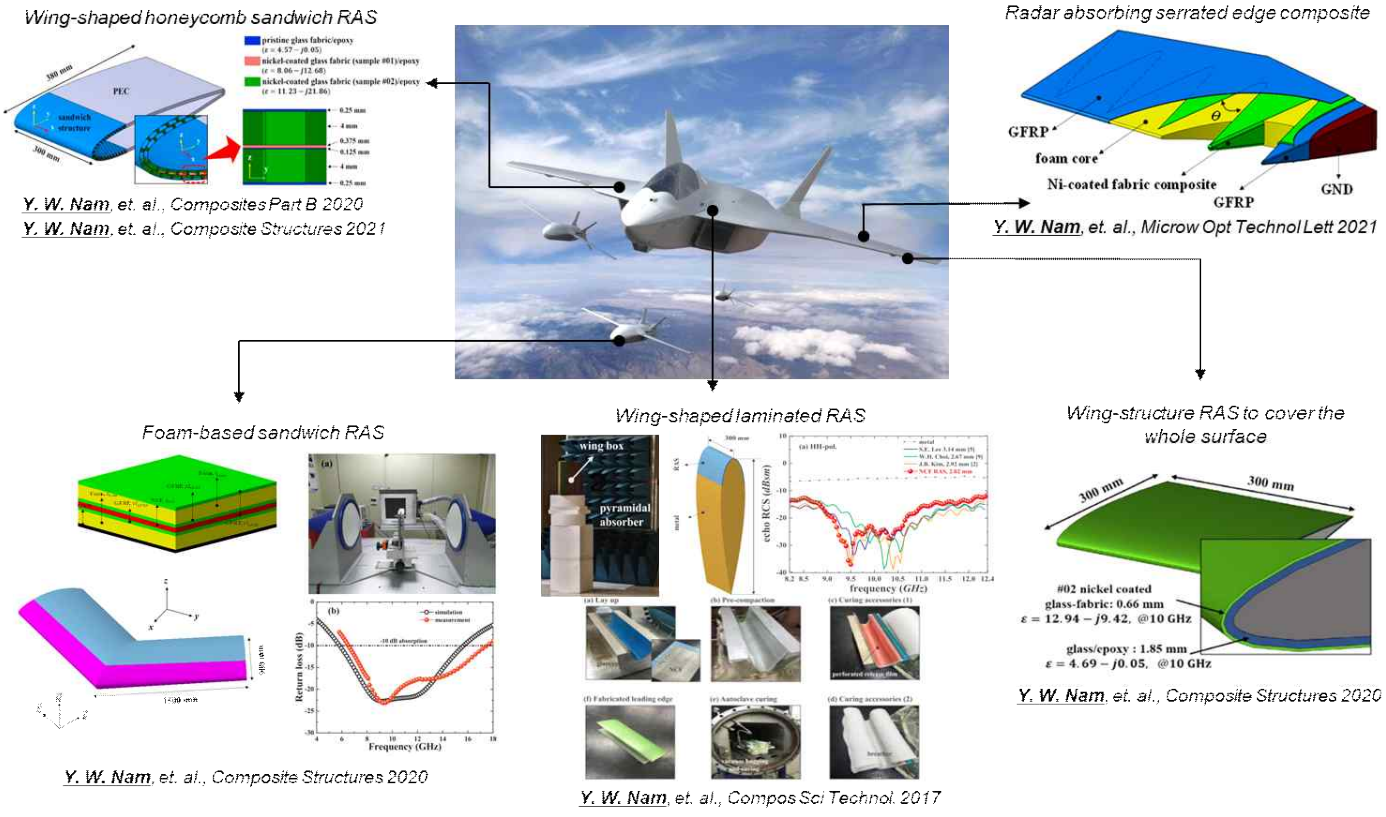
- 2024 ㈜한국항공우주산업(KAI) 항공우주논문상 장려상(허성행, 서한준 연구원)
- 2024 한국복합재료학회 추계학술대회 최우수 논문상(임채환 연구원)
- 2024 항공우주시스템공학회 추계학술대회 우수 발표 논문상(홍동준 연구원)
- 2024 한국항공우주학회 학부생 논문경진대회 우수상(임채환 연구원)
- 2024 한국항공우주학회 학부생 논문경진대회 준우수상(허성행, 서한준 연구원)
- 2024 항공우주시스템공학회 전국 대학생 캡스톤디자인 경진대회 ㈜대한항공상(윤준영, 김태완 연구원)
- 2023 한국복합재료학회 추계학술대회 우수 발표 논문상(장한나 연구원)
- 2023 ㈜한국항공우주산업(KAI) 항공우주논문상 장려상(석창민, 장한나 연구원)
- 2023 한국항공우주학회 학부생 논문경진대회 장려상(석창민 연구원)

8. 수행 중인 프로젝트

- 극초음속 비행체용 고내열 및 전자파제어 복합소재 기술개발, 국방과학기술진흥연구소(주관: 대한항공)
- 적 위협체 기만을 위한 RCS 출력 강화 기술 개발, 한국연구재단(주관: 한국항공우주산업㈜)
- 최신 탐지 위협 대응 무인기용 메타구조 스텔스 융합기술, 국방과학기술진흥연구소(주관: 대한항공)
- 극초음속 비행체 고성능 all-ceramic 산화물 스텔스 레이돔 복합재 핵심기술 개발(한국연구재단)
- 다종 임무장비 운용을 위한 개방형 무인기 플랫폼 기술, 국방과학기술진흥연구소(주관: 대한항공)
- 산업수요기반 고효율·안전 항공핵심기술 연구센터(ERC), 한국연구재단(NRF)
- 첨단모빌리티 융합기술 연구센터(GRRC), 경기도
- 지구관측 및 다중궤도통신중심의 VLEO 임무에 대한 타당성 분석 및 기초 설계 연구, LIG D&A
- 우주기술실용화촉진지원사업, 우주항공청

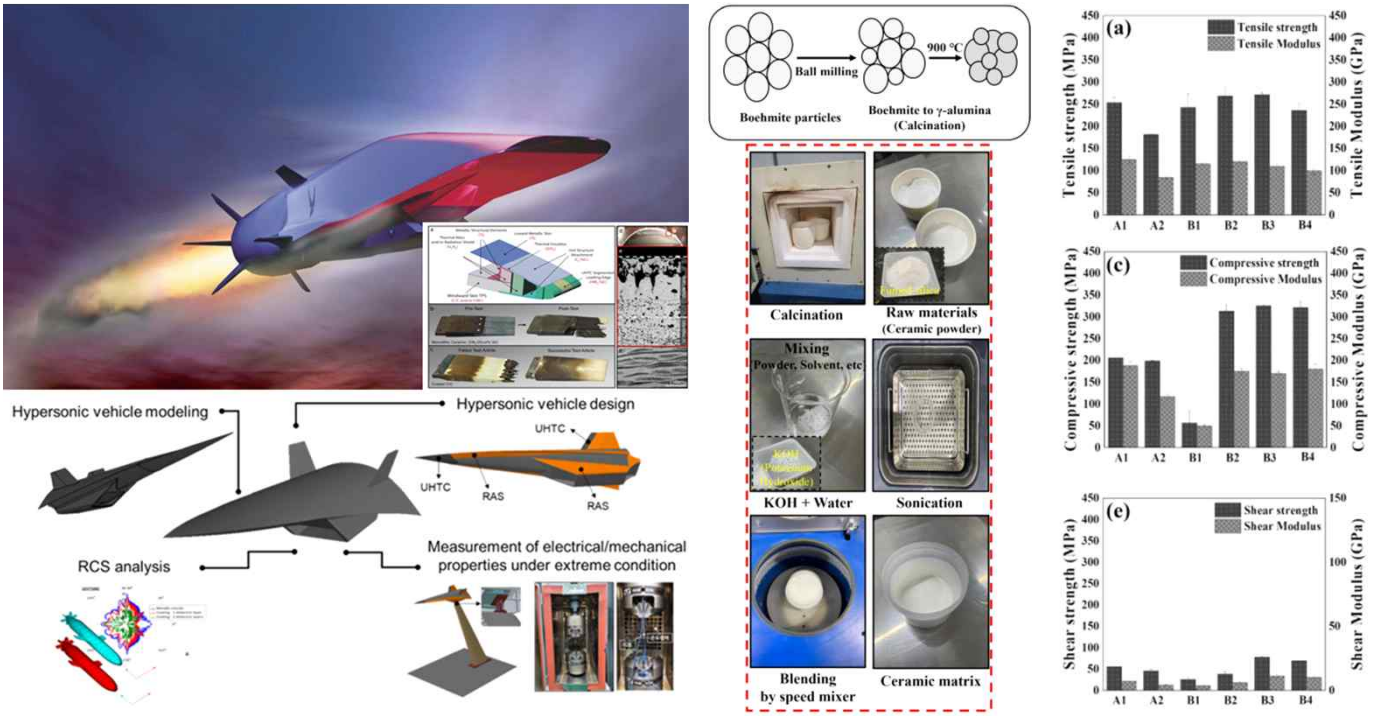
9. 연구 내용 상세 소개

스텔스 복합재 구조 연구



스텔스 복합재 소재 개발 및 구조 설계

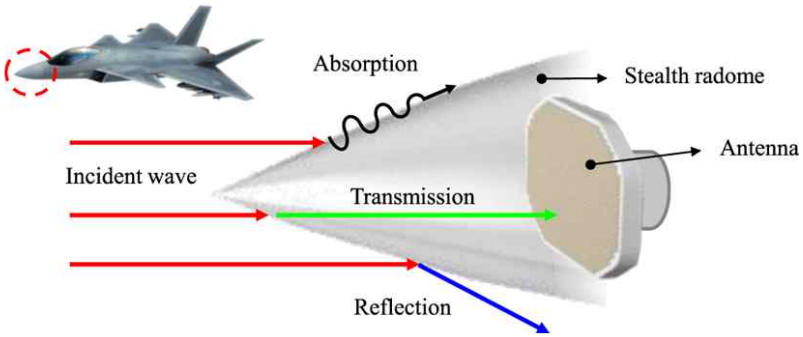
Y. W. Nam, et. al., Advanced Composites and Hybrid Materials 2026

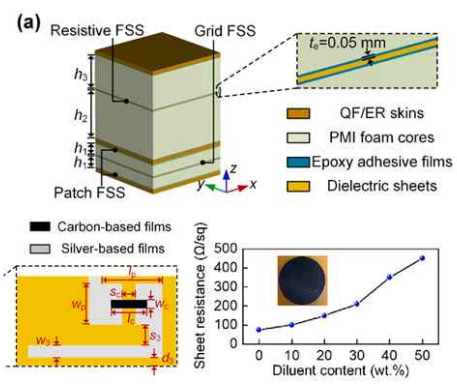


극초음속 미래 비행체 세라믹 복합재 구조 설계

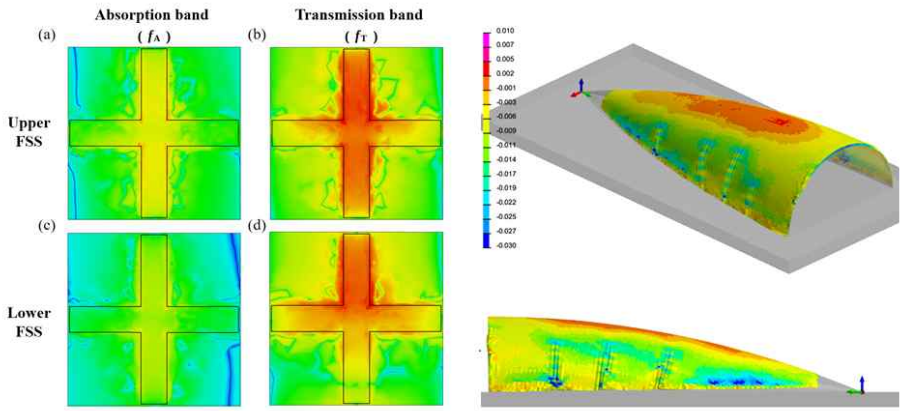


Aircraft radome structure





Schematic of sandwich rasorber



E-filed on FSS

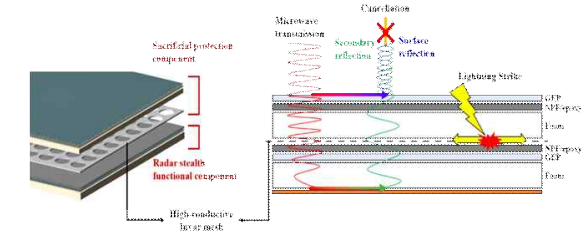
스텔스 레이돔 개발 및 구조 설계

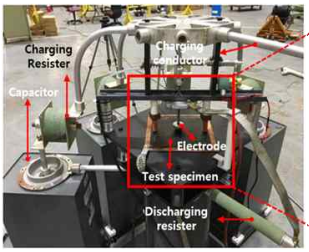
극한 환경용 기능성 복합재 구조 연구

Korea Aerospace University
KOREAN AIR
UtahState University MECHANICAL AND AEROSPACE ENGINEERING
MISSISSIPPI STATE UNIVERSITY
International research collaboration

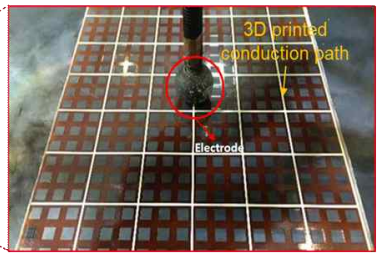



Lightning strike testing: leading edge wing shaped composite

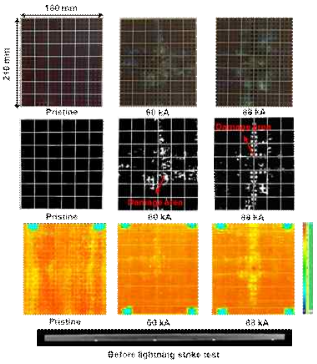




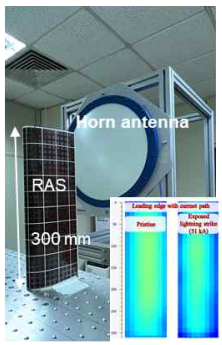
High current impulse generator



Lightning strike test setup



Damage evaluation after lightning strike test



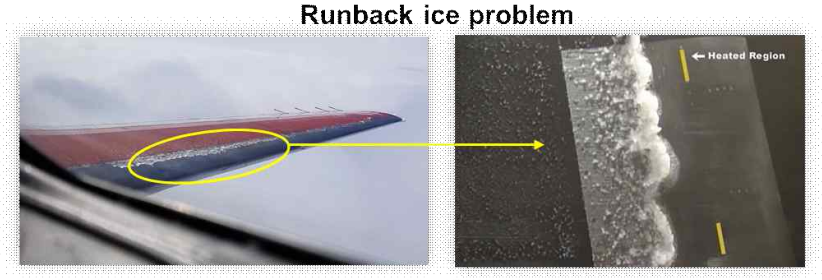
Stealth performance

극한 환경용 낙뢰 피격 보호 복합재 구조 설계 및 시험

Korea Aerospace University
IOWA STATE UNIVERSITY
경상국립대학교

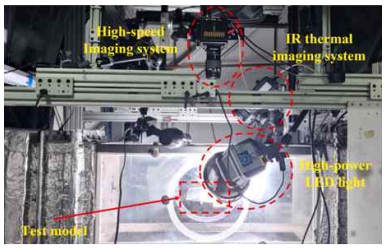
Y. W. Nam, et. al., Aerospace Science and Technology 2025

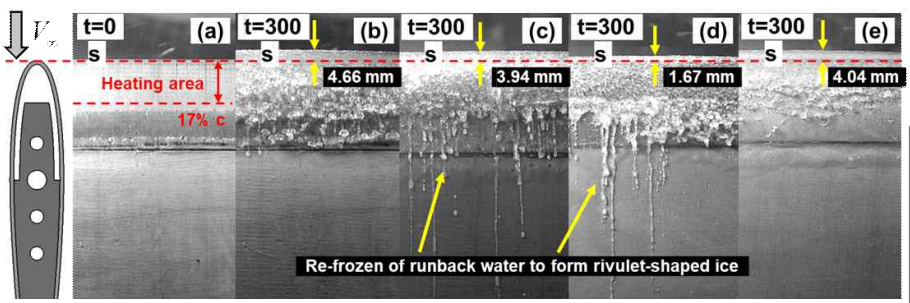
Runback ice problem



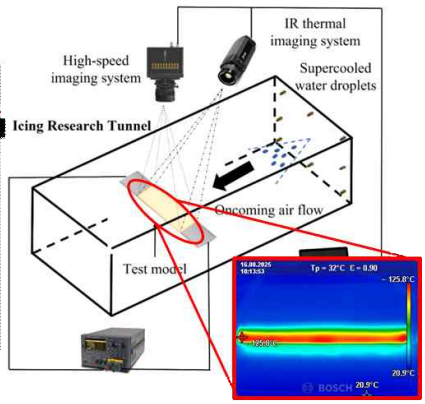
3D scanning images of composites

Experimental setup



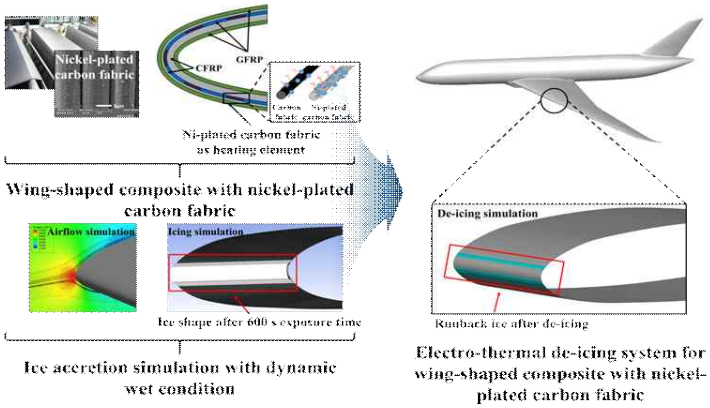


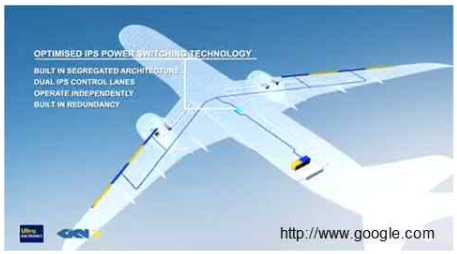
※ Heat: Electrothermal heating
SHS: Superhydrophobic surfaces



전기-열/초소수성 방식의 미래 비행체 하이브리드 방제빙 복합재 구조

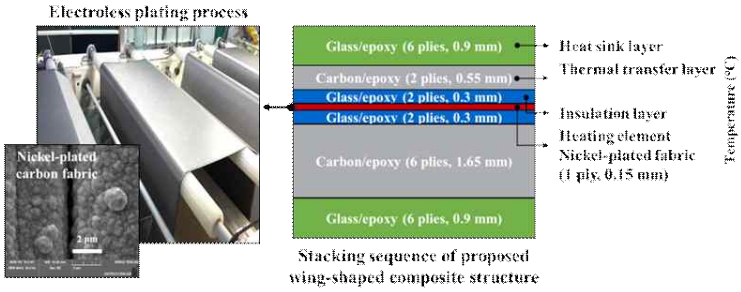
Y. W. Nam, et. al., Composite Structures 2022

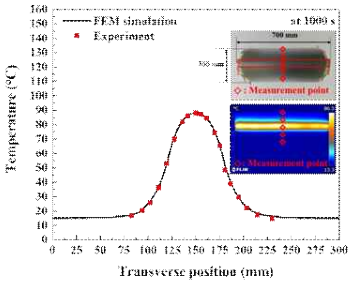




Boing 787 Ice protection system (metal mesh heating film); conventional approach

Wing-shaped multi-functional heating composite





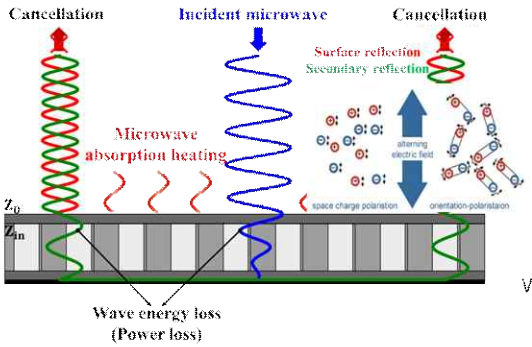


Configuration and stacking sequence of the wing-shaped composite structure

전기-열 방식의 미래 비행체 방제빙 복합재 구조 설계 및 시험



Microwave generators inside the blades (ideal)



Multi-functional heating honeycomb sandwich composite

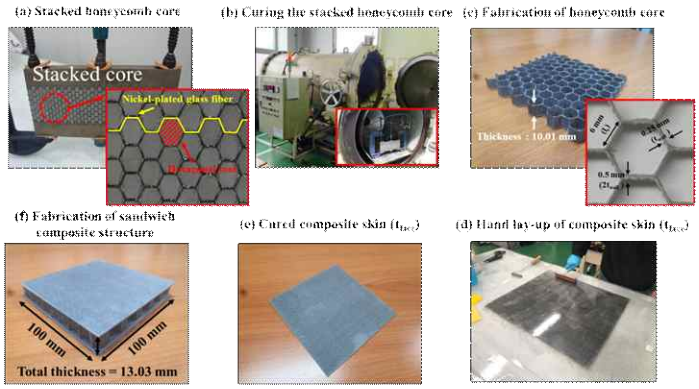
Power loss density vs. Electric field

$$P_e = \pi f \varepsilon_0 \varepsilon_r^{im} \left| e^2 \right| \quad (1)$$

Temperature of lossy dielectric materials

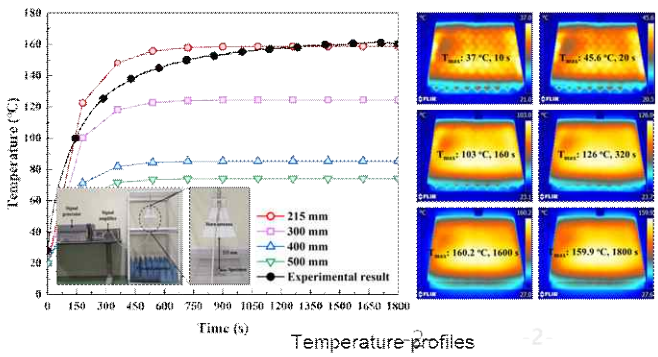
$$\rho C_p \frac{\partial T}{\partial t} = k \nabla^2 T + P_e \quad (2)$$

Where ρ is the material density, C_p is specific hea capacity of material, k is thermal conductivity of material, and T is the temperature



Fabrication process flow of proposed composite

High-performance EM wave heating honeycomb composite



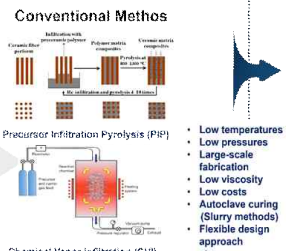
Temperature profiles

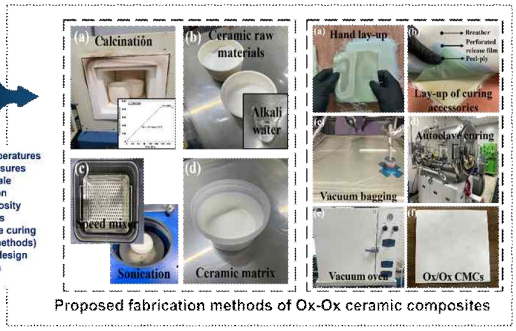
풍력 블레이드용 발열 복합재 구조

우주 환경 기능성 복합재 구조 연구

VLEO vehicle[1]

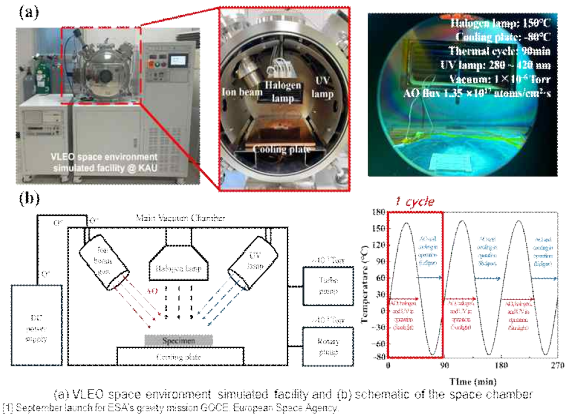






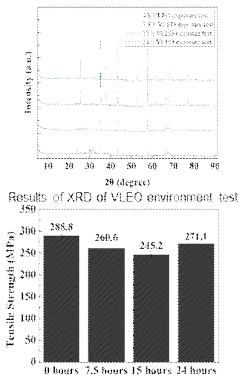
Proposed fabrication methods of Ox-Ox ceramic composites

Develop a new concept of plasma thruster discharge wall using Ox/Ox CMCs



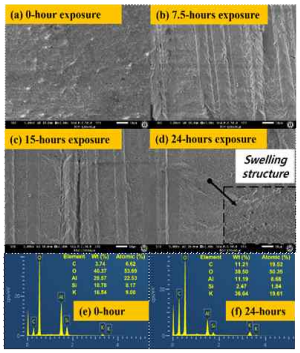
(a) VLEO space environment simulated facility and (b) schematic of the space chamber

[1] September launch for ESA's gravity mission GOCE European Space Agency



Results of XRD of VLEO environment test

Results of tensile strength



SEM images after exposure to the VLEO environment (a) 0 hours, (b) 7.5 hours, (c) 15 hours, (d) 24 hours, (a) and EDS results (e) 0 hours, (f) 24 hours

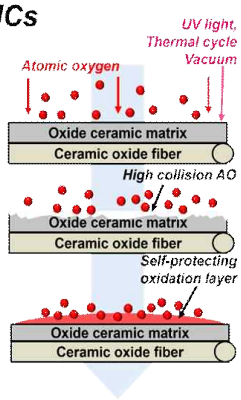
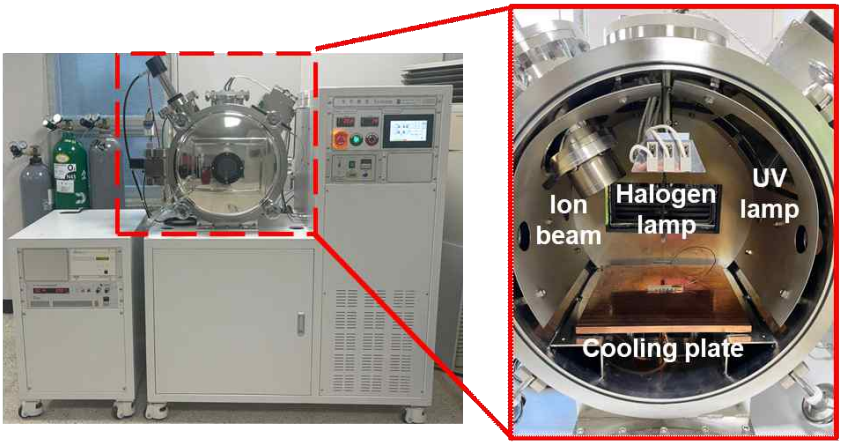


Diagram of the AO damage process on oxide/oxide ceramic matrix composite

우주 추력기 복합재 구조 설계



VLEO space environment simulated facility @ KAU

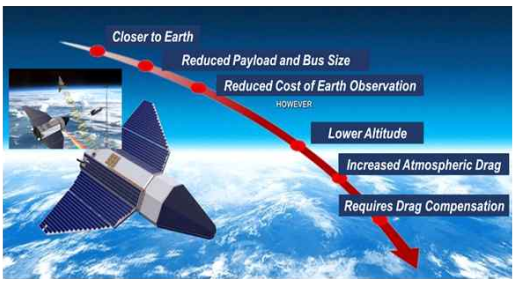
VLEO environment ground simulation

1. High vacuum : 10^{-6} ~ 10^{-7} Torr
2. Atomic oxygen : ~10^{22}atoms/cm^2
3. UV light : UVC ~ UVA
4. Thermal cycling : -80 ~ 150℃
5. MMOD (~5.3 eV)

Effects on exposed materials

1. Structural modification and mass loss
2. Surface erosion by AO attack
3. Fatigue cracking by thermal cycling
4. Delamination by collisions with MMOD
5. Severe damages by synergistic effects

VLEO Space Applications



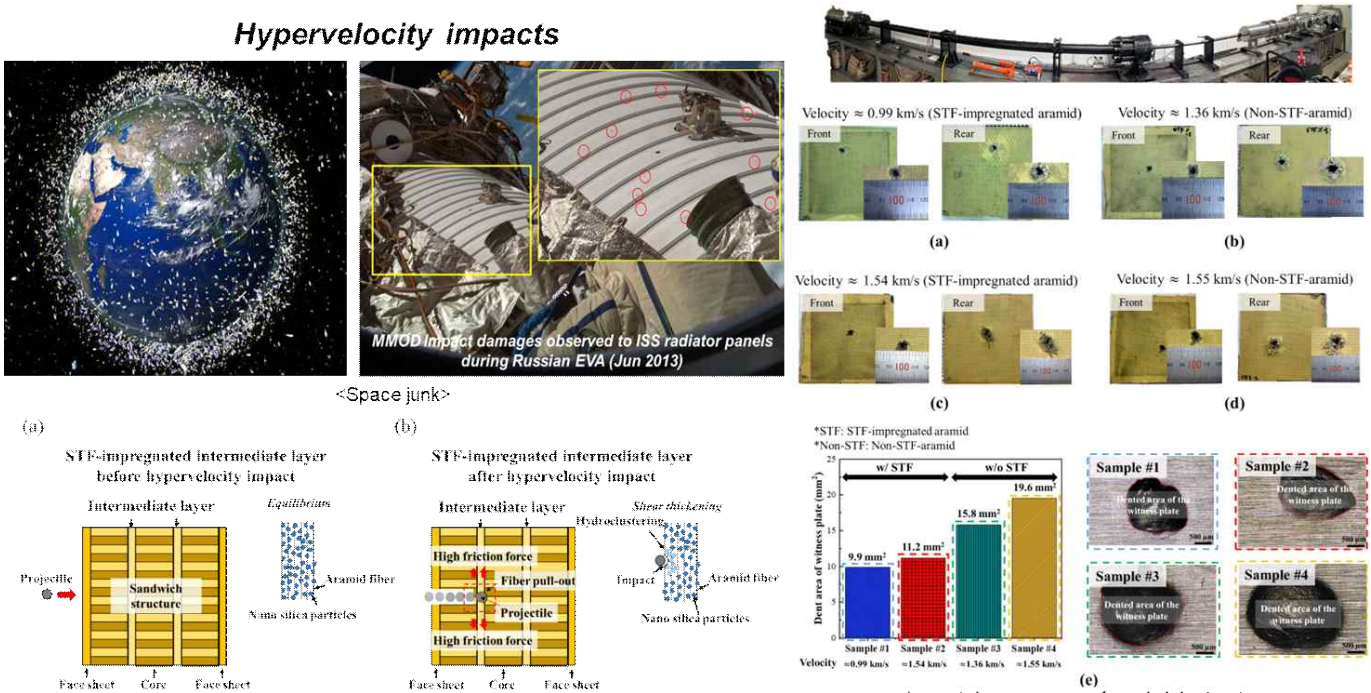
A design example of a VLEO satellite[1]

Development of advanced composite materials for space application

VLEO space environment simulation facility	*Development of functional composites for enhanced VLEO resistance*
Understanding of the VLEO effects on typical composites	*Functionalized nano-sized fillers Reinforced nanocomposites*
Investigation of environmental characteristics after VLEO exposure	*Selection of VLEO resistance coating*

[1] Sutlieff, Gary, Lucy Berthoud, and Mark Strickcombe. "Using satellite data for CBRN (chemical, biological, radiological, and nuclear) threat detection, monitoring, and modelling." *Surveys in Geophysics* 42 (2021): 727-755.

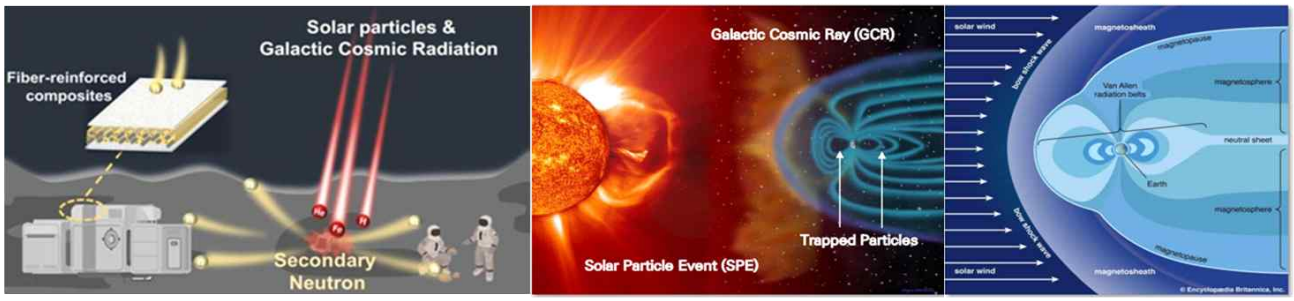
우주 환경 저항 다기능 복합재료 개발



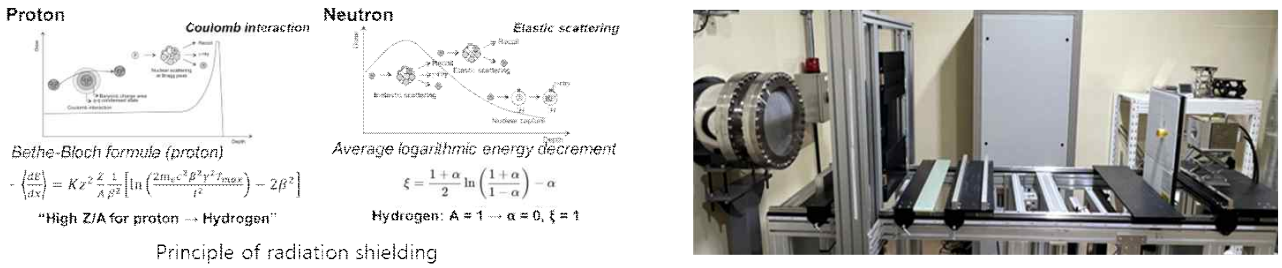
<Space junk>

Impact damage area of sandwich structure

우주 쓰레기 초고속 충돌 차폐 복합재 구조 설계

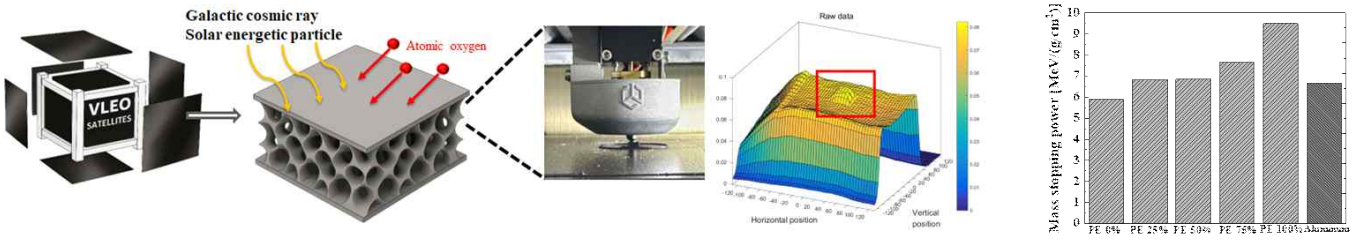


Cosmic radiation



Principle of radiation shielding

Radiation test



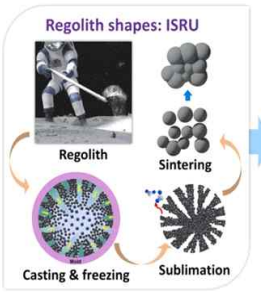
3D printed cosmic radiation shielding composite structure

Visualization of the 2D IC data

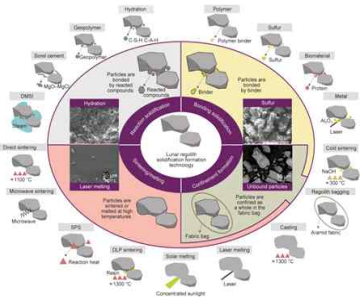
Mass stopping power of radiation shielding materials

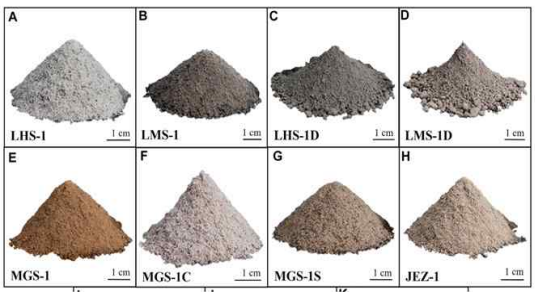
우주 방사선 차폐 복합재 구조 설계



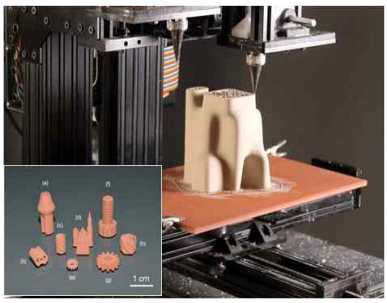


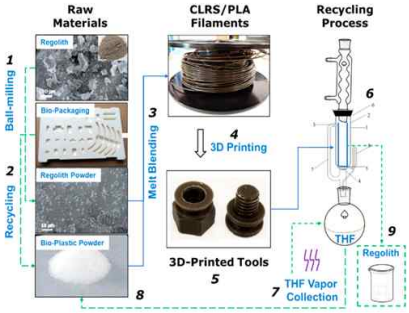






<Lunar regolith>





ISRU (In-Situ Resource Utilization) 복합재료 공정 기술

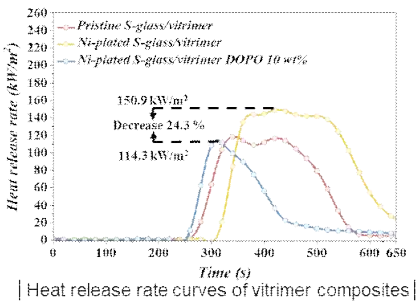
배터리팩 복합재 연구



| Battery pack enclosure of electric vehicles |

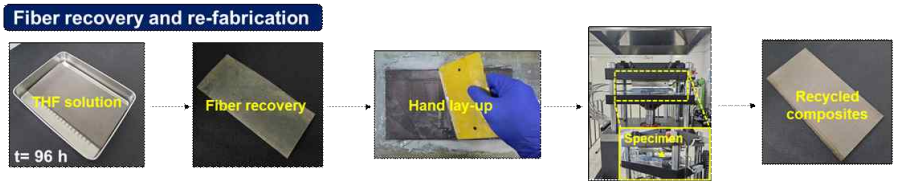


| Battery pack enclosure of eVTOL |

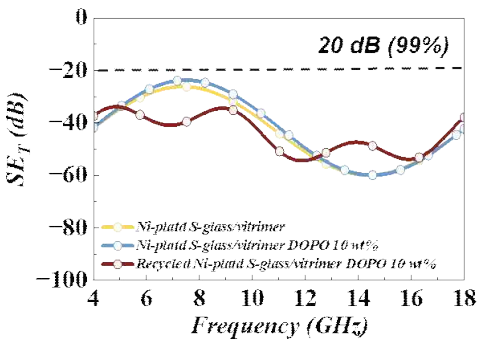


| Heat release rate curves of vitrimer composites |





| Recyclability of vitrimer composite |



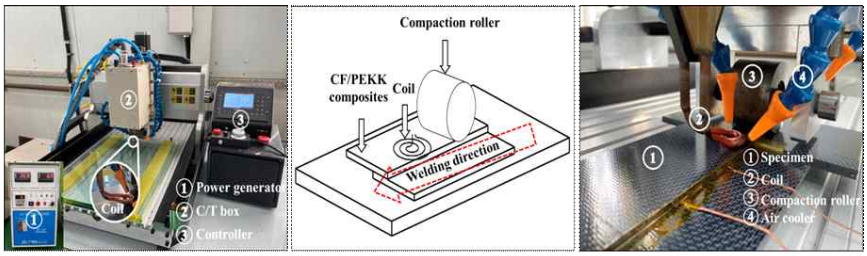
| EMI shielding performance of vitrimer composites |

자동차 배터리팩 재활용 비트리머 복합재 개발

유도 용접 열가소성 복합재 연구

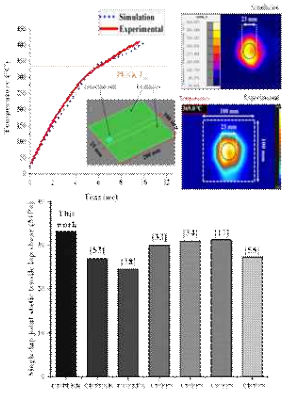


Thermoplastic composites used in eVTOL platform

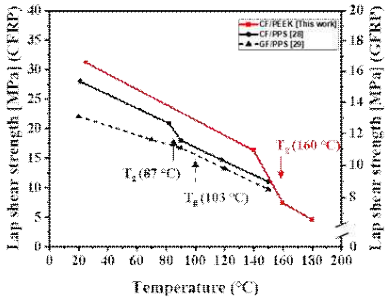


Experimental set-up of continuous induction welding of CF/PEKK composite

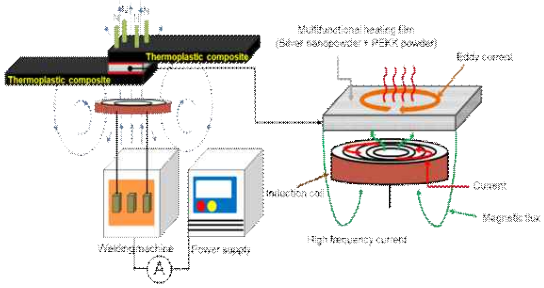
Static and fatigue behavior



Effect of hygrothermal condition



Multi-functional heating film as susceptors



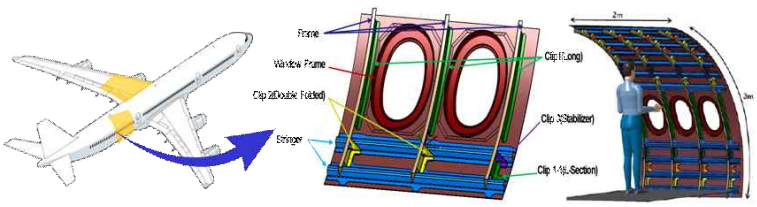
***Y. W. Nam**, et. al., Advanced Composite Materials 2022*

***Y. W. Nam**, et. al., Journal of Reinforced Plastics and Composites 2023*

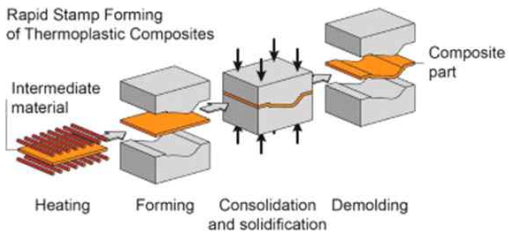
***Y. W. Nam**, et. al., Journal of Composite Materials 2021*

열가소성 유도 용접 공정 기술 시뮬레이션 및 피로 평가

Out of Autoclave 공정 활용 복합재 연구

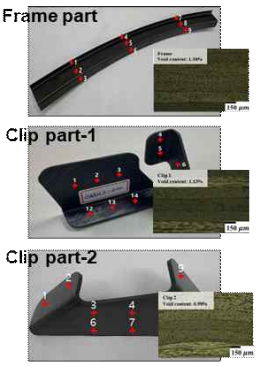


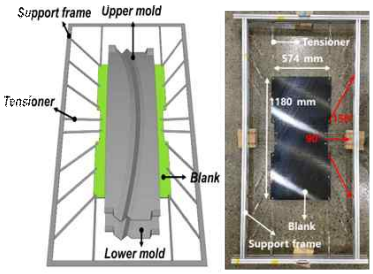
The development of fuselage part for thermoplastic composites



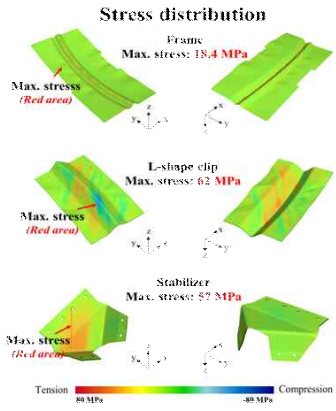
Stamp forming consolidation process







Boundary conditions of stamp forming analysis and Blank set-up

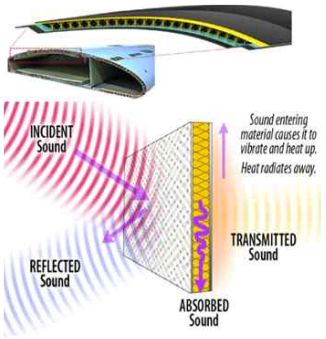


고속 열성형 해석 시뮬레이션 및 제작을 통한 성형성 평가

3D 프린팅 공정 활용 다기능 복합재 연구

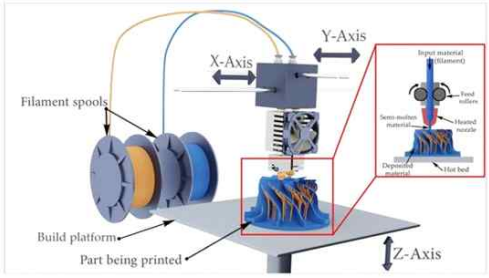


Composite and speciality materials for Urban Air Mobility

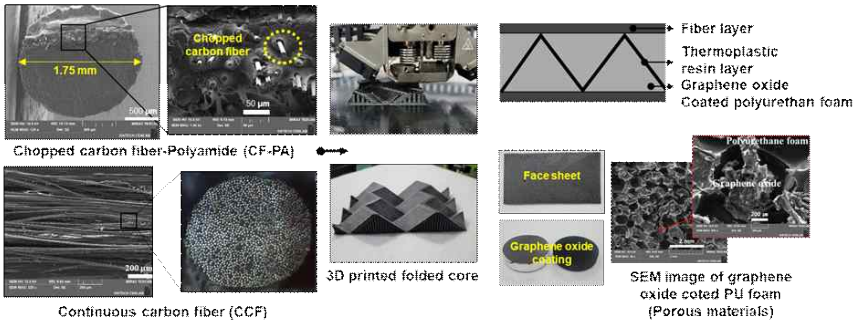


Sound absorbing composite concept

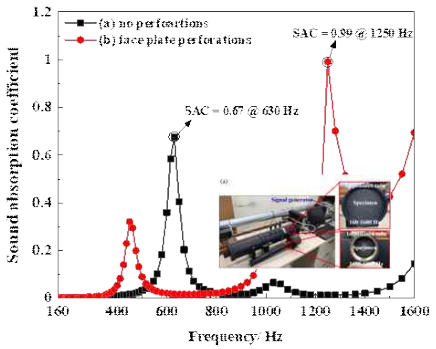
Y. W. Nam, et. al., Composite Structures 2024



Fused Deposition Modeling (FDM) 3D printing

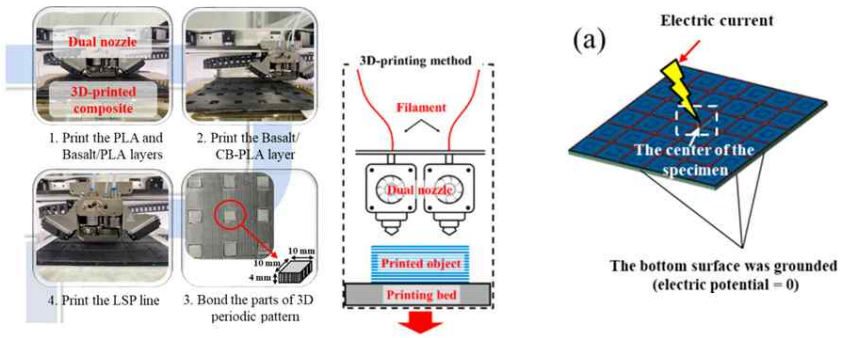


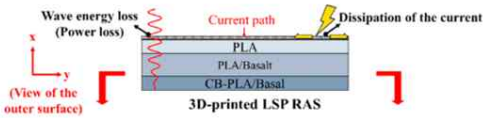
Fabrication of 3D printed sound-absorbing folded core sandwich thermoplastic composite

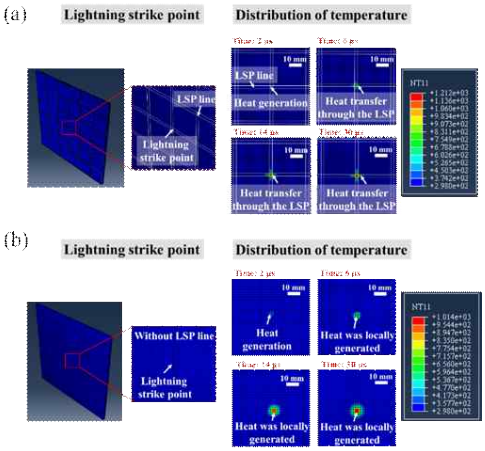


Sound absorbing performance in low frequency

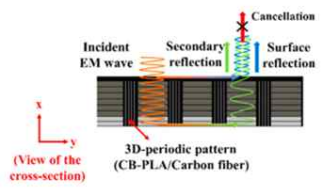
3D 프린팅 UAV 적용 소음 흡수 복합재 구조 설계



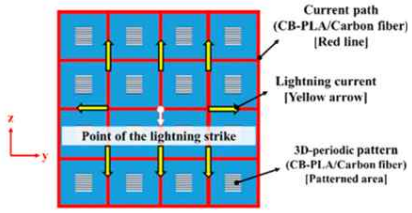




Reducing the intensity of the microwave reflection



Lightning strike protection using the current path



3D-printed radar-absorbing composites with lightning strike protection using the high current path

3D 프린팅 낙뢰 보호 복합재 구조 설계