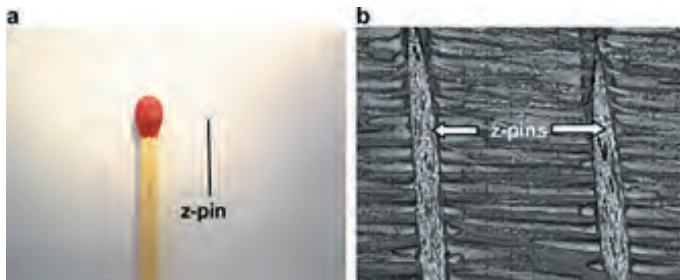


# 06

## Composite material Z-pinning



### Inventor

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### Team

Material Structure Research Team

### Status of right

- US : 9434110
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### Title

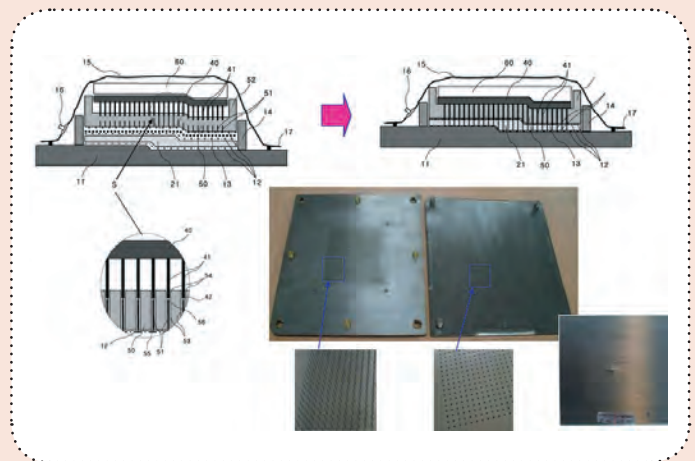
- METHOD OF MANUFACTURING UNEVENNESS SHAPED Z-PIN AND Z-PIN MANUFACTURED USING THE SAME AND COMPOSITE STRUCTURE INCLUDING THE Z-PIN
- COMPOSITE LAMINATED STRUCTURE REINFORCED BY INSERTING PINS, A METHOD AND A APPARATUS FOR MAKING THE SAME AND A METHOD FOR MAKING THE APPARATUS

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## Outline of Technology

Technology of inserting pins in a thickness direction of a composite material laminated structure to prevent interlayer separation or strengthening a connection part by driving pins into a joint part when a plurality of composite material members are formed integrally.



## Technical features and advantages

### Distinctiveness

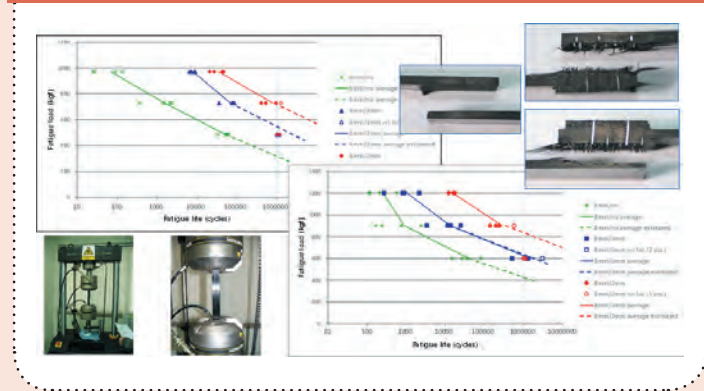
- It does not cause any waste of materials, and a pre- and post-process of removing compressed foam before and after molding, and projecting pins is not necessary.

## Technical features and advantages

### Technical effects

- Since little influence is given to a process of manufacturing current composite materials, immediately applicable in industrial fields.
- Upon comparison with drilling work and use of metal fasteners, insertion of an automated Z-pin can achieve a 70% reduction on manufacturing costs.

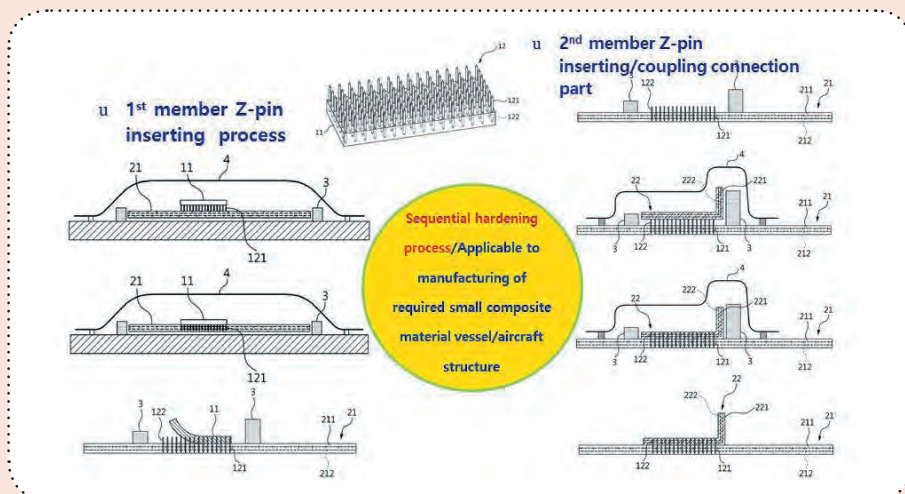
### Tension Fatigue Test Results for Joint Part



## Technical detail

**This technology is in a state in which a sample product has been manufactured, and has been applied to manufacturing of small vessels in Korea.**

- Static tensile test results for unevenness shaped pin single-lap shear joint
  - Pin having a diameter of 0.5 mm, made of stainless steel, and having a pin density of 2.2% (an interval of 3 mm) and 4.9% (an interval of 2 mm).
  - According to the joint part having a thickness of 6 to 8 mm, static strength is increased by 54 to 69%.
- Tensile test results for unevenness shaped pin single-lap shear joint part
  - Pin having a diameter of 0.5 mm, made of stainless steel, and having a pin density of 2.2% (an interval of 3 mm) and 4.9% (an interval of 2 mm).
  - Fatigue strength is improved by about 100%, and fatigue life is improved by 100 times.



## Composite material Z-pinning

### Market and future prospects

- AZTEX applied this technology to connect the engine bay door to the air inlet duct of a rear fuselage for F/A-18 E/F Super Hornet instead of a titanium fastener, so that the cost was reduced by \$83,000 per aircraft and the weight was reduced by 17 kg per aircraft.
- Applied to the cargo door of C17 Globemaster and Boeing-Sikorsky RAH-66 Comanche. X-CorTM that has the sandwich structure to which the Z-pinning technology is applied is applied to the tail cone in UH60M Black Hawk, so that a weight is reduced by 21 kg per helicopter.
- Examples of use for roll over bar of Formula 1 Racing Car



# Applications

- Carbon fiber/glass fiber composite materials are broadly used for light weight products that require higher specific stiffness/specific strength than metal such as aerospace/wind turbine blade/boat/yacht/high speed train/automobile/sporting goods.
- For the purpose of use of metal pins such as stainless steel in Korea and broad use in various fields of manufacturing composite materials, research into Z-pinning patch/elastic pad concept has been conducted to be applied to the various fields of manufacturing composite materials.

