SIP 戦略的イノベーション創造プログラム
Cross-ministerial Strategic Innovation Promotion Program

NEDO

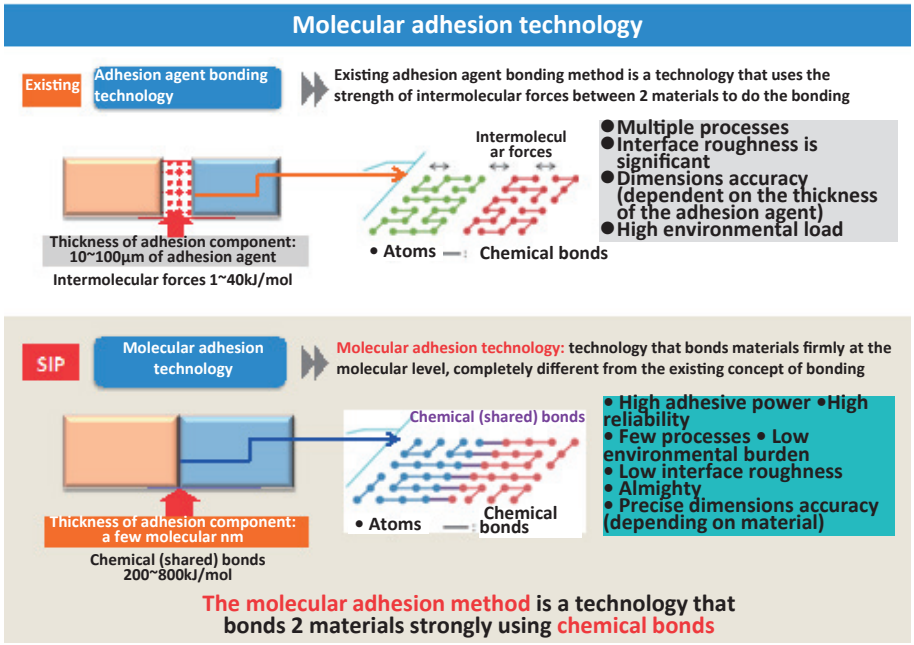
10

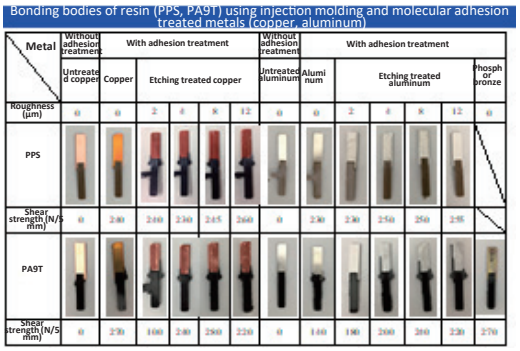
Innovative Design / Manufacturing Technologies

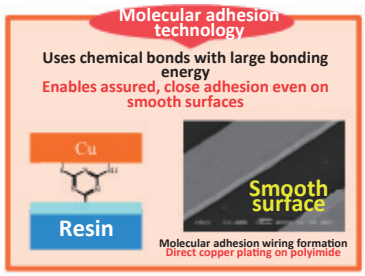
Adhesion Technology Developed by Our Country's Cornerstone Manufacturing Industry Increasing the Competitiveness of the Manufacturing Industry with Hetero-homogamy Joining

About this Project

Molecular adhesion technology is an original technology that has traditionally been taken up by Iwate University. At its core it is not an adhesive (intermolecular force) between objects, but a technology for firm adhesion using chemical bonds. This technology enables bonding between differing types of materials or materials that have heretofore been difficult to adhere to one another (e.g., polyethylene and metal, silicone rubbers, plastic and ceramics, etc.). This enables the simplification of bonding methods (metal plates for etchings), and also features high strength adhesion and high heat resistance. With its commercialization and compatibility research carried out in a number of industrial fields such as automobiles, medicine, and semiconductors, and with the cooperation of Iwate University's Industrial Technology Center, this technology encourages traditional industry in a number of ways.

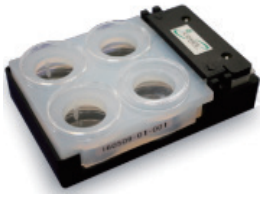






Test Uses / Application Examples

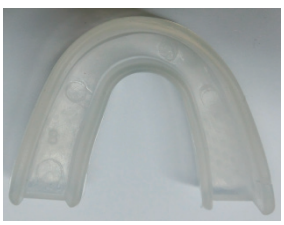
■ Automatic culture exchange system



World's first laboratory scale-sized automatic culture exchange system integrated with micro-structure technology

Sulfur Chemical Laboratory Inc. / ICOMES LAB Co., Ltd.

■ Medical mouthpieces

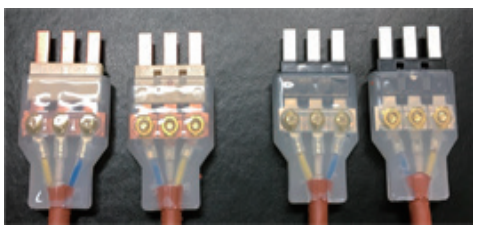


Medical mouthpieces

Meets hygiene standards

Non-toxic junctions

■ Highly airtight connectors for automobiles



Highly airtight connectors that combine resin and metal

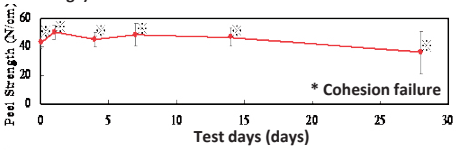
Aiming to move the technology to regional companies

Research Achievements

The performance, reliability, and safety of molecular bonding technology

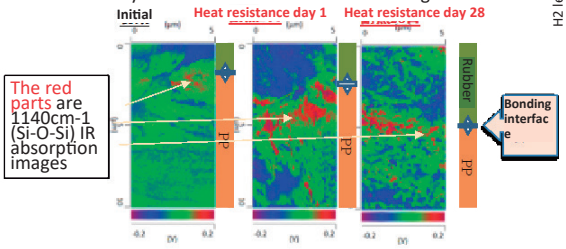
Adhesion bonding interlayer control using molecular bonding technology is already being minutely analyzed at the molecular and atomic level. As the bonding sides are the outermost surface modifications (chemical ornamentation) of the materials being bonded, covalent bonds between materials are used to join them firmly, making this a bonding technology with long-term reliability and safety.

Bonding performance / long-term reliability (Peeling strength when kept in 80ºC storage)



Polypropylene and rubber bonded materials bonded with molecular adhesion technology can be relied on to not peel for long periods of over 30 days in an 80ºC heat-resistance test.

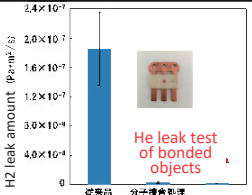
Surface analysis of the bonded items above using AFM-IR



The bonding interface of polypropylene and rubber show -O-Si-O bonding with molecular adhesion, verifying it on a molecular level.

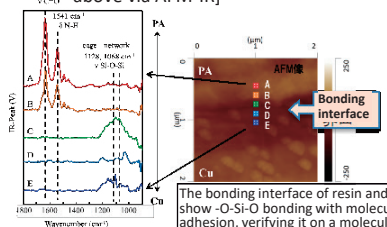
Safety

It is possible to ensure not only the safety of heating tanks by using resin and metals made to be airtight to ensure there are no He leaks, but also to ensure the reduction of pinholes which can be vectors of bacteria intrusion.



No helium leaks with molecular adhesion

[Bonding interface analysis of cross-sections of test items above via AFM-IR]



The bonding interface of resin and metal show -O-Si-O bonding with molecular adhesion, verifying it on a molecular level.

Future Outlook

As our innovative composite component developments have the heat dissipation, airtightness, noise reduction, and electromagnetic shielding that are so important to the search for new bonding mechanisms, the development of new bonding agents, and next-generation components (thanks to our furthering of comprehensive R&D to reach the maximum potential of molecular bonding technology), we are aiming for reconstruction from the 2011 Tohoku earthquake and our country's domestic manufacturing innovation by enhancing, spreading and promoting this technology and furthering the production of various items with new adhesion bonding functionality.

Molecular adhesion technology ripple effects

"Connecting" the development of several processes

① Resin molds
Power electronics
Semiconductor molds

② Less pasting of bonding agents
Airtight sealing
Ceramic composite forms

③ Plating, metallization
Decorative plating
Plating for textiles

Responding to the electronics field
Use as a "Connecting" technology from semiconductor chips to products

Responding to the many manufacturing fields

Automotive
- Lightened bonding of different materials
- Thermal hoses
- Lifetime cation coating

Power/electronics
- High frequency / high-speed transmission
- Power electronics sealing
- EM wave shielding

Aeronautics/Space
- CFRP bonding
- Silicon bonding
- Highly airtight bonding

Healthcare/food
- DNA chips
- Medical devices
- Food-related products
- Wearable technology

Other
- High heat diffusion bonding
- Highly airtight environment-resistant products

岩手大学 IWATE UNIVERSITY

地方独立行政法人 岩手県工業技術センター IWATE INDUSTRIAL RESEARCH INSTITUTE

Research Theme : Research and development of innovative manufacture using molecular adhesion technology

Members : IWATE University, Iwate Industrial Research Institute, Sulfur Chemical Laboratory Inc., ALPS ALPINE CO., LTD.

Contact : Center for Regional Collaboration in Research and Education, Iwate University

Utilization Hub : Iwate University, Iwate Industrial Research Institute