Stable and Durable Polymer Materials

A method for processing Polymer of Intrinsic Microporosity (PIM) to increase durability and stability of the polymer

Georgia Tech researchers have developed a method to create highly stable organic-inorganic hybrid PIM-1 materials with chemical resistance using vapor phase infiltration (VPI). During the vapor phase infiltration process, PIM-1 absorbs and traps inorganic material. The inorganic materials form networks throughout the PIM-1 and offer solvent resistance as well as potentially reducing the aging time by "propping open" the microspores. This treatment does not significantly inhibit the mechanical properties of PIM-1 but it does increase the long-term stability and chemical durability. Infiltrated PIM materials can withstand concentrated solvents (e.g., tetrahydrofuran, chloroform, dichloromethane) for over a month, while the non-infiltrated PIMs dissolve in minutes. Because VPI can be used to infiltrate the PIM-1 with different inorganic materials, new functionalities like catalysis are also possible. To date, research has focused on PIM-1 but this technique can be applied to other porous polymeric materials.

Summary Bullets

- **Resistant** – Processed PIMs last longer in solvents than unprocessed PIMs
- **Increased Stability** – Infiltration processing decreases aging time and increases durability
- **Tunable** – Broad range of possible interactions with guest molecules

Solution Advantages

- **Resistant** – Processed PIMs last longer in solvents than unprocessed PIMs
- **Increased Stability** – Infiltration processing decreases aging time and increases durability
- **Tunable** – Broad range of possible interactions with guest molecules
- **Versatile** – Tunable infiltration process allows for additional properties to be induced

Potential Commercial Applications

- Storage devices
- Sorbents
- Catalysts
- Sensors

Background and More Information

Polymer of intrinsic microporosity 1 (PIM-1) is a polymer whose rigid backbone results in high levels of free volume or “microporosity”. PIM-1 can be dissolved in various solvents and solution-processed into different shapes for targeted applications (e.g., wovens, fibers, etc.) The unique combination of microporosity and solution-processability makes PIM-1 an ideal material for applications like absorption, membrane separation, etc. However, when exposed to organic solvents or vapors, due to its solution-processability, PIM-1 experiences rapid aging, swelling, and even dissolution. There is a need for a post synthesis process that stabilizes PIM-1 without compromising porosity.

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IP Status

: US20200325295A1

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