Liquid Conductive Self-Coacervates Via Associative Phase Separation In Water

Tech ID: 33309 / UC Case 2022-818-0

BACKGROUND

Water-based viscoelastic liquids that are highly enriched in polyelectrolytes are attractive for a number of applications including low-surface tension materials useful in industries such as cosmetics and food science. In nature, polyelectrolyte-based viscoelastic liquids are used by organisms as underwater adhesives in salt-water environments. Such viscoelastic liquids, called coacervates, typically form with electronically *inactive* polyelectrolyte.

An electronically active coacervate could enable such applications such as electrically conducting underwater adhesives and water-based photoactive viscoelastic pastes. This could be useful for environmentally benign soldering materials, sensing, color-sensitive coatings and the enhancemeent of photochemically driven chemical reactions.

A research team at UC Santa Cruz has designed a series of conjugated polyelectrolytes (CPEs) that can form electronically active liquid coacervate phases.

TECHNOLOGY DESCRIPTION

Most conjugated polyelectrolytes do not support a concentrated liquid coacervate phase because they are highly prone to π-stacking interactions that strongly favor a solid amorphous or crystalline state.

Instead, these new materials are made up of alternating conjugated polymers, where one monomer includes ioinic side chains with any counterion and the other monomer has polar, nonionic side chains.

Particular examples of monomer combinations (for a given set of sidechains) to form the alternating conjugated polymer backbone that can satisfy the above requirements include fluorene, phenylene, thiophene, benzothiadiazole, bithiophene, benzodithiophene, thienothiophene, and carbazole. The sidechain identity (whether ionic or polar nonionic) can be permuted between the two monomers.

Examples of such compounds include:

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OTHER INFORMATION

KEYWORDS

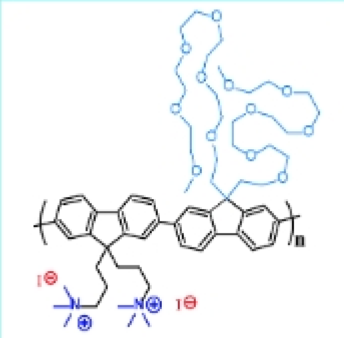
coacervate, self-coacervate, polyelectrolyte, adhesive, electrically conductive adhesive, underwater adhesive, electrically conductive underwater adhesive, conductive polymer, liquid coacervate, electrically active liquid coacervate, polymer

CATEGORIZED AS

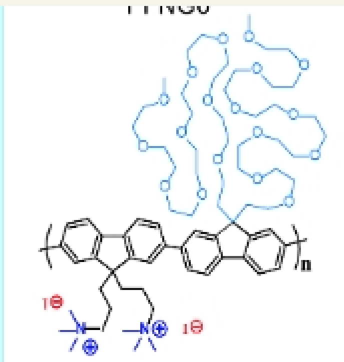
- **Materials & Chemicals**
  - Polymers

RELATED CASES

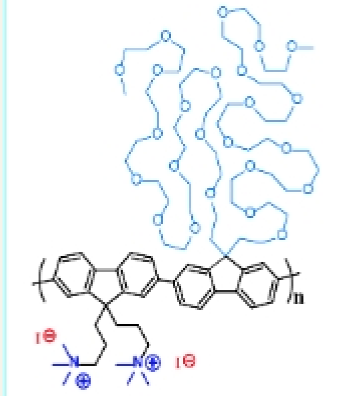
2022-818-0



PFNG6



PFNG9



PFNG12

In these exemplary compounds, the backbone is polyfluorene. One fluorene monomer has two ionic (quaternary methylammonium) sidechains with iodide counterions. The second fluorene monomer has oligo(ethyleneglycol sidechains with variable length, corresponding to 6 (PFNG6), 9 (PFNG9) and 12 (PFNG12) ethyleneglycol units.

The formation of either simple or complex coacervates involved dissolving the appropriate CPEs in water without added salt and then combining each polymer with appropriate amounts of aqueous KBr, resulting in a final desired KBr and polymer concentration. The solution can then be heated for several hours at elevated temperatures (approximately 70 deg. C) to form the liquid coacervates.

APPLICATIONS

- Electrically conductive adhesives
- Underwater adhesives
- Electrically conductive underwater adhesives
- Lead free solder
- Electrically conductive viscoelastic pastes
- Sensors
- Enhancers for photochemically driven chemical reactions

ADVANTAGES

First ever electrically conductive liquid coacervate material

Environmentally friendly relative to other adhesives

Works underwater

INTELLECTUAL PROPERTY INFORMATION

Patent Pending

RELATED MATERIALS

- Excitonically Coupled Simple Coacervates via Liquid/Liquid Phase Separation - 10/28/2022

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Complementary Conjugated Polyelectrolye Complexes As Electronic Energy Relays

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