Nature-inspired self-healing for organic electronic

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Background

Organic electronics and conjugated polymers - an introduction:

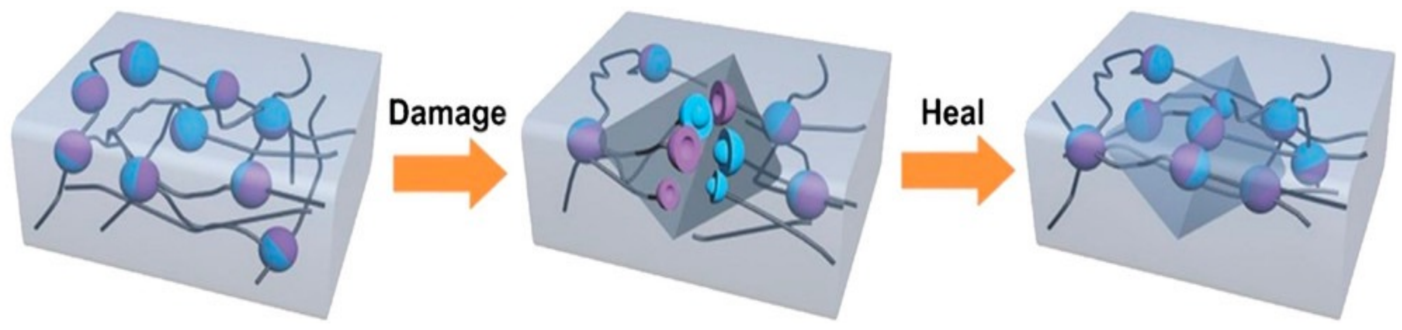


Figure 1. Image showing self-healing properties of polymers via reversible chemical bonds [1]

- Conjugated polymers are a class of organic semiconductors that have gained interest due to the crucial role that they play in the development of organic electronics.
- They are made of repeating units with a polymer backbone consisting of conjugated double bonds. This creates a delocalized pi-electron system allowing enhanced electronic properties.
- They also exhibit self-healing traits due to the presence of various chemical and physical properties such as dynamic bonds, reversible cross-links, and hydrogen bonding.
- Revolutionary applications of stretchable electronic devices: soft robotics, e-skin sensors, wearable electronics, and energy-storage devices.

Figure2. diagram demonstrating the different applications of organic electronics[1]

Major challenges and drawbacks

- Previous synthesized devices have failed due to physical deformations, scratching and wear in tear upon their applications.
- It is hard to achieve a balance between mechanical, electronic and chemical properties. Often materials that are good conductors, and have a well-established extended pi-conjugation backbone, end up having very rigid structures. This is a failure when the goal is achieving ideal self-healing.

Possible solutions

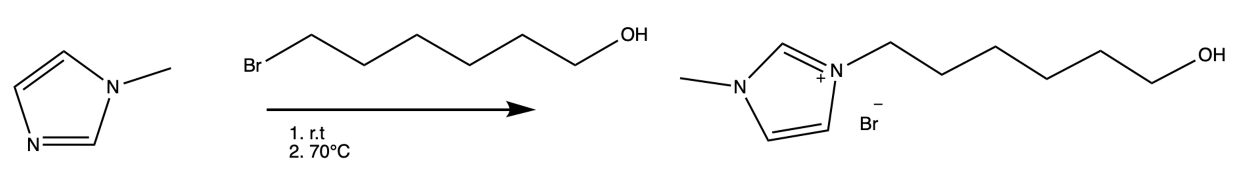
- Structural optimisation
- Chemical modification
- Ionoelastomers based on polyionic liquids (PILs): possess inherent elasticity and flexibility as well as high conductivity due to their ionic properties. This is ideal for electronic devices due to the thermal and chemical stability of such material resulting in long-term durability and longevity under any environmental pressures.

Method

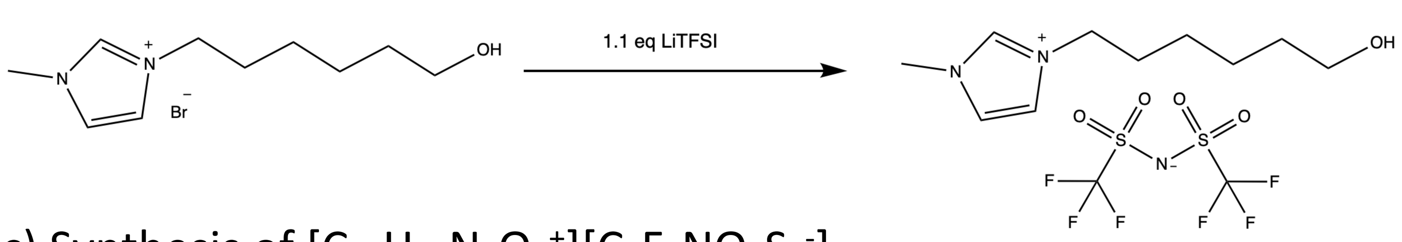
Synthesis of the monomer $[C_{13}H_{21}N_2O_2^+][C_2F_6NO_4S_2^-]$

- This is the initial step in making the ionic liquid
- Synthesised in a lab

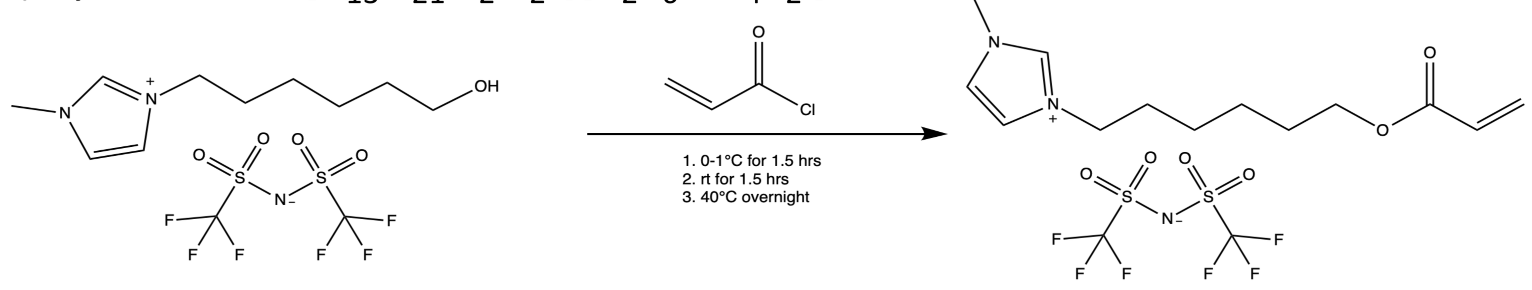
a) Synthesis of $[HOC_6EI]Br$



b) Synthesis of $C_{12}H_{19}F_6N_3O_5S_2$



c) Synthesis of $[C_{13}H_{21}N_2O_2^+][C_2F_6NO_4S_2^-]$



Results

- Successful synthesis of the monomer enables the future synthesis of polymers with predictable properties and functionalities.

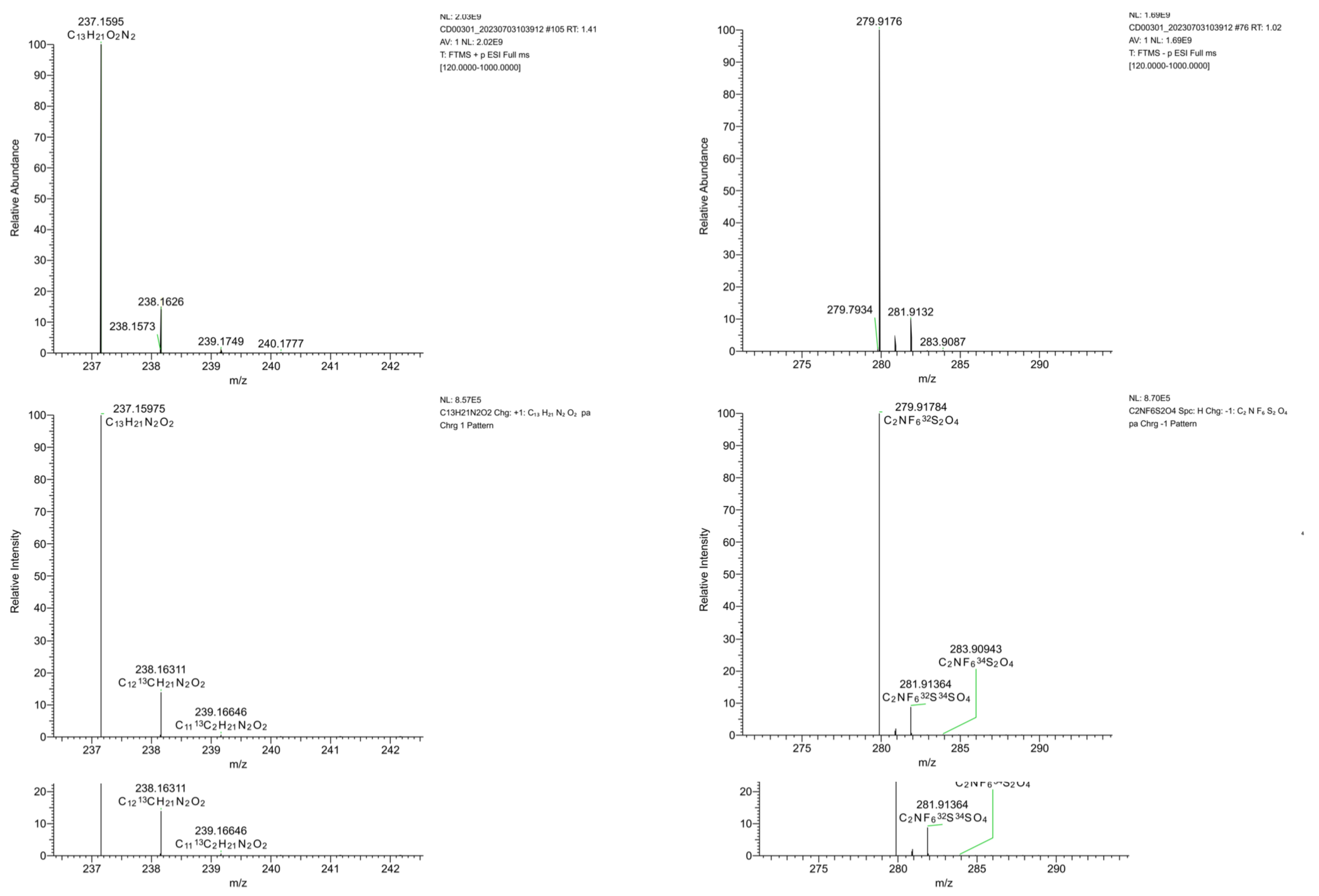
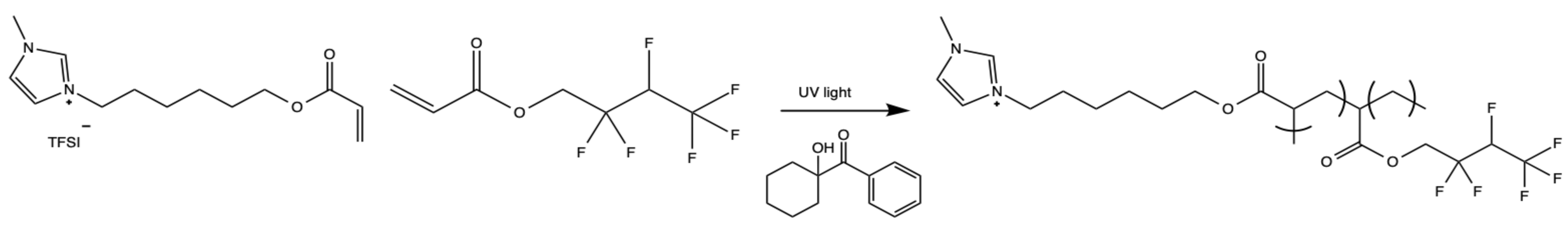


Figure 3. Mass spectrometry of $[C_{13}H_{21}N_2O_2^+][C_2F_6NO_4S_2^-]$

Future work

- The monomer synthesised will be polymerised
- This material will be stretchable, highly transparent, and conducting
- The polymer can be blended with another to optimise properties such as improved charge transport as well as mechanical and thermal stability.



References

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