Transfer of Self-assembled Template-guided Polyaniline onto a Flexible Substrate

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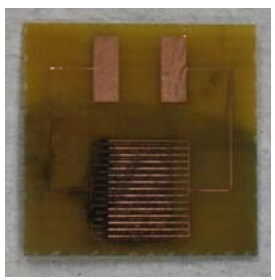
Introduction

- Polyaniline (PANi), a conductive polymer, has been assembled in defined patterns using electrostatically-addressable templates and transferred to polymeric substrates.[1]
- Profitable manufacturing of flexible conductive materials, such as nanoelectronics or biosensors,[2] requires better understanding the transfer conditions.
- Previous work on this topic shows only possibility of transfer, not optimal conditions.

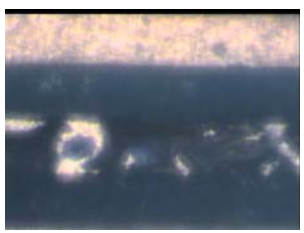
Methods

- Created 1% PANi solution in DMF doped with 10-camphor-sulfonic acid, filtered.
- Assembled PANi by dipping 10 volt charged template into solution for 1 minute.
- Transferred by compressing template with polyethylene terephthalate (PET) substrate for 5 minutes
  - Temperature: 93 to 154 °C
  - Pressure: 0.5 to 5 metric tons

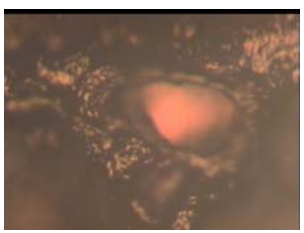


Template: copper on PI

Compression press



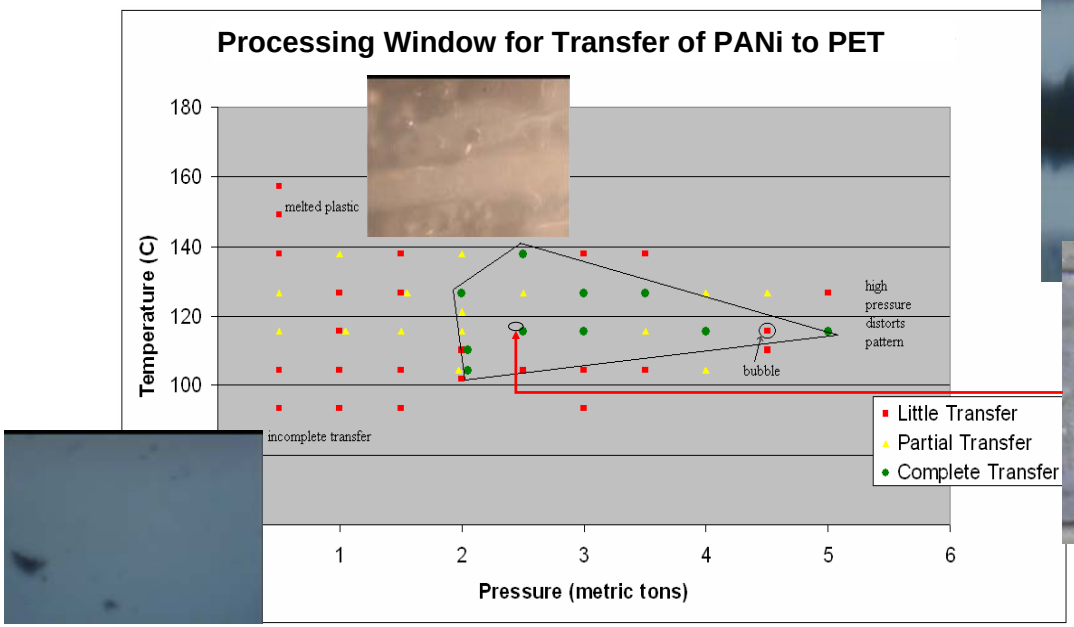
Assembled PANi (100X)

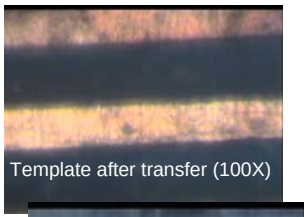


Assembled (200X)

Results

- Transfers occur best at temperatures between 115°C and 135°C.
- Pressure must be at least 2 metric tons for good transfer.
- Below 105°C there is only incomplete transfer.
- Above 140°C the plastic degrades.





Template after transfer (100X)

Complete transfer (100X)

Complete transfer

Conclusions

- Temperature and pressure equally affected transfer of PANi to PET.
- Optimum transfer occurred at about 115°C and 2.5 metric tons of pressure.
- Future research is needed to determine the effects of compression time and substrates other than PET.

Acknowledgements

Dr. Ming Wei and Jia Shen, UML

References

1. Kim B., Koncar V., Dufour C., J Appl. Polym. Sci., 101, 1252-1256 (2006)
2. Wei M., Tao Z., Xiong X., Kim M., Lee J., Somu S., Sengupta S., Busnaina A., Barry C., Mead J., Macromolecular Rapid Communications, 27(21), 1826-1832 (2006)

Connections to Chemistry

- Polymer structures of modern science
- Intermolecular forces (IMFs) that cause “sticking”
- Adding a charge to create motion
- Experiment in seeing and explaining IMFs. Which IMF’s are occurring and where

Connections to Math

- Graph of temperature, pressure, and quality
- Creating 3D topographical map of the 3 variables
- Problem solving – students discover what temperature and pressure work well.

Research Experiences for Teachers at Northeastern University
Claire Duggan, Program Director

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