The influence of thermal conductivity of poli(benzofuran-*co*-arylacetic acid) by crosslinking reactions with diamines

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Introduction: Thermal conductivity is the property that determines the working temperature levels of material, and it is an essential parameter in problems involving steady-state heat transfer. This study reports the preparation of new polymers based on poly(benzofurane-co-arylacetic acid) cross-linkage reaction. The molecular structure of poly(benzofurane-*co*-arylacetic acid) offers enormous design flexibility, which allows tailoring the properties of the cured materials for a wide range of applications. The crosslinking reaction was completed by opening the lactone ring with different diamines having different reactivities. ss-^{13}C-NMR and FTIR clearly confirmed the structure of the crosslinked poly(benzofurane-co-arylacetic acid). In this work we illustrate the use of two simplified back and front detection cases in order to measure the thermal diffusivity directly (back photopyroelectric) and thermal effusivity (front photopyroelectric) of our samples. In principle, in the photopyroelectric method, the temperature variation of a sample exposed to a modulated radiation is measured with a pyroelectric sensor situated in intimate thermal contact with the sample.

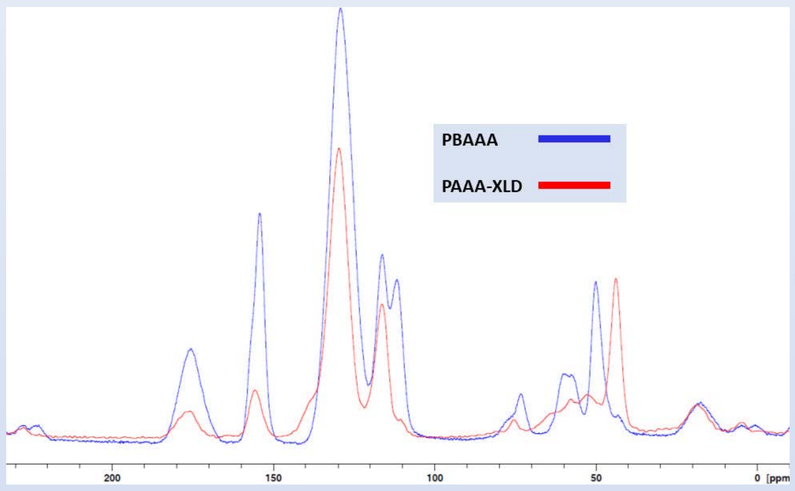
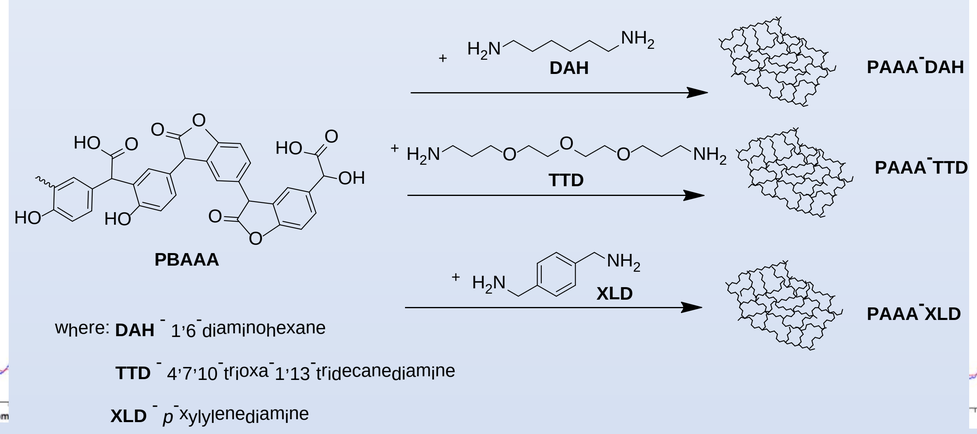


Figure 1: ^{13}C ss-NMR spectra of the starting polymer **PBAAA** (blue line), and **PAAA-XLD** (red line)



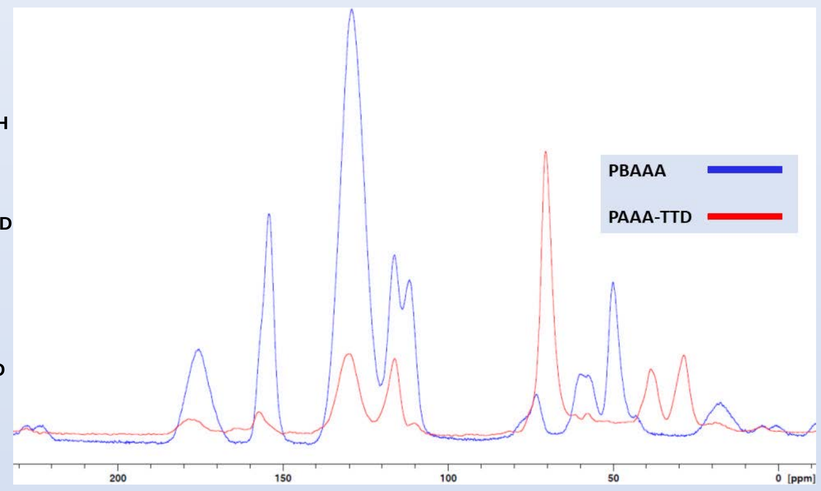


Figure 2: ^{13}C ss-NMR spectra of the starting polymer **PBAAA** (blue line), and **PAAA-TTD** (red line)

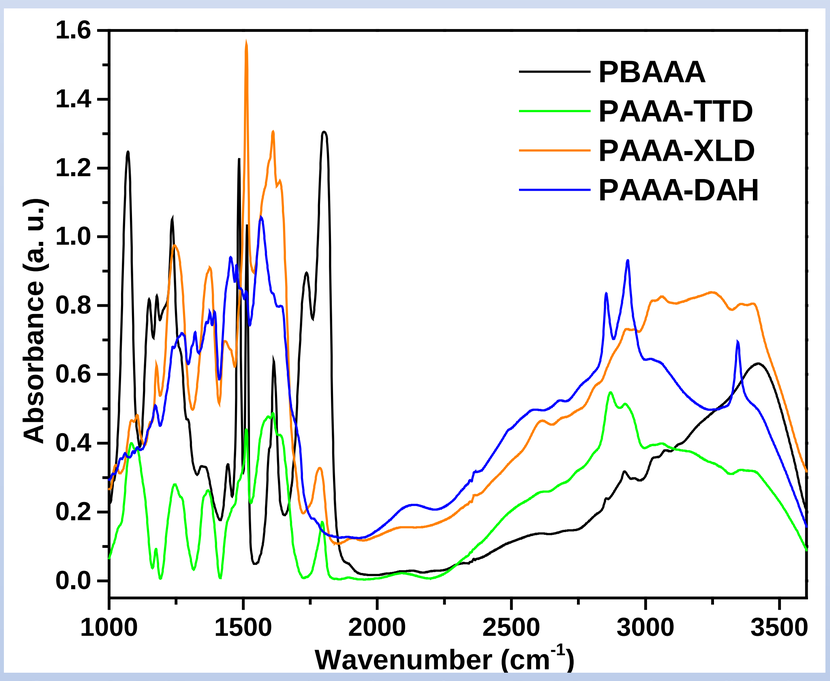


Figure 3: FTIR spectra of starting polymer **PBAAA** and crosslinked polymers **PAAA-DAH**, **PAAA-TTD**, **PAAA-XLD** respectively

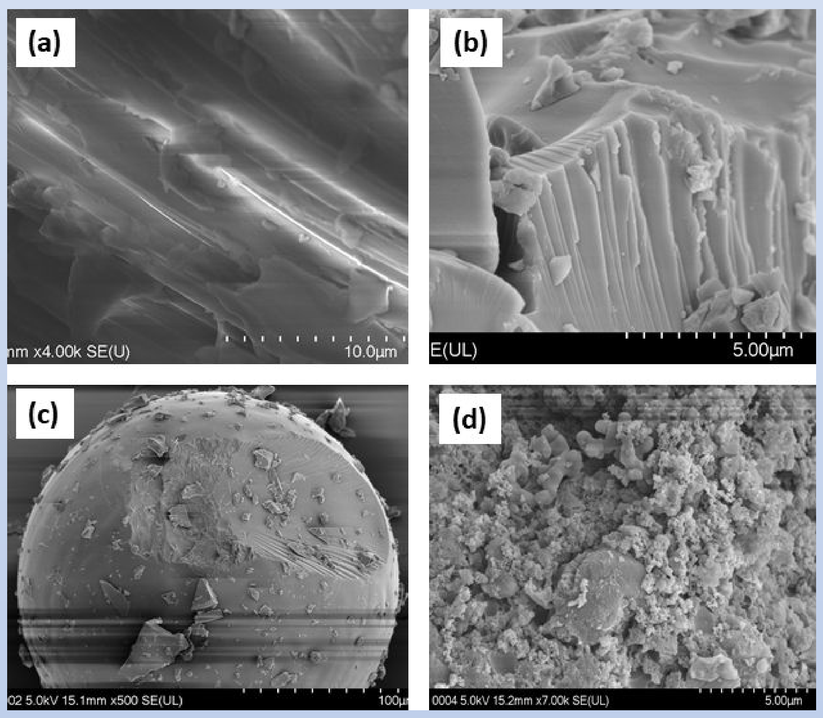


Figure 4: Scanning Electron Microscopy image of **PBAAA** is like an arboreal self-assembling structure (a), while crosslinked polymer **PAAA-DAH** has a lamellar structure morphology (b) **PAAA-TTD** forms capsules (c) and the crosslinked polymer **PAAA-XLD** is like a porous polymer (d).

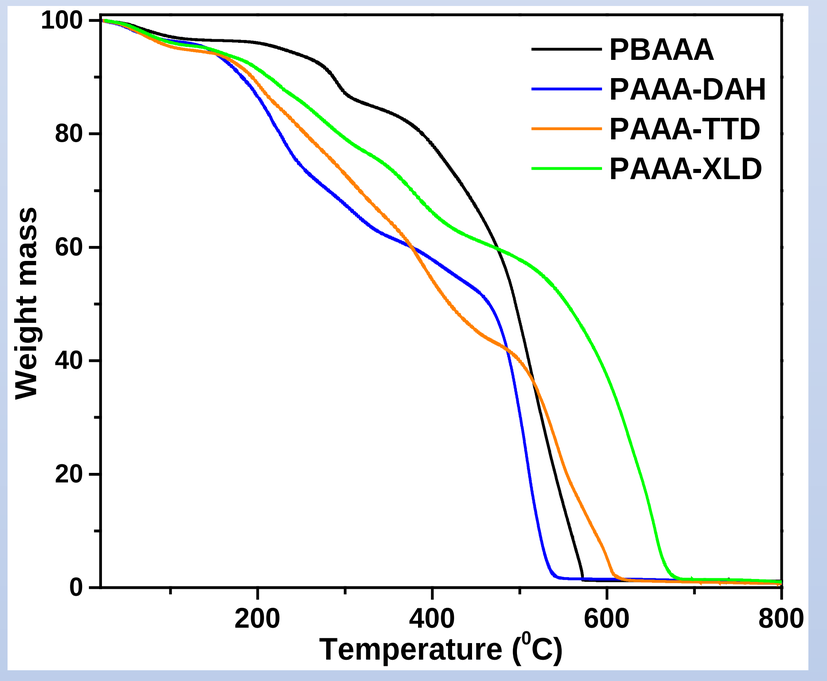


Figure 5: Thermogravimetric analysis (TGA) curves of starting polymer **PBAAA** and crosslinked polymers **PAAA-DAH**, **PAAA-TTD**, **PAAA-XLD** respectively

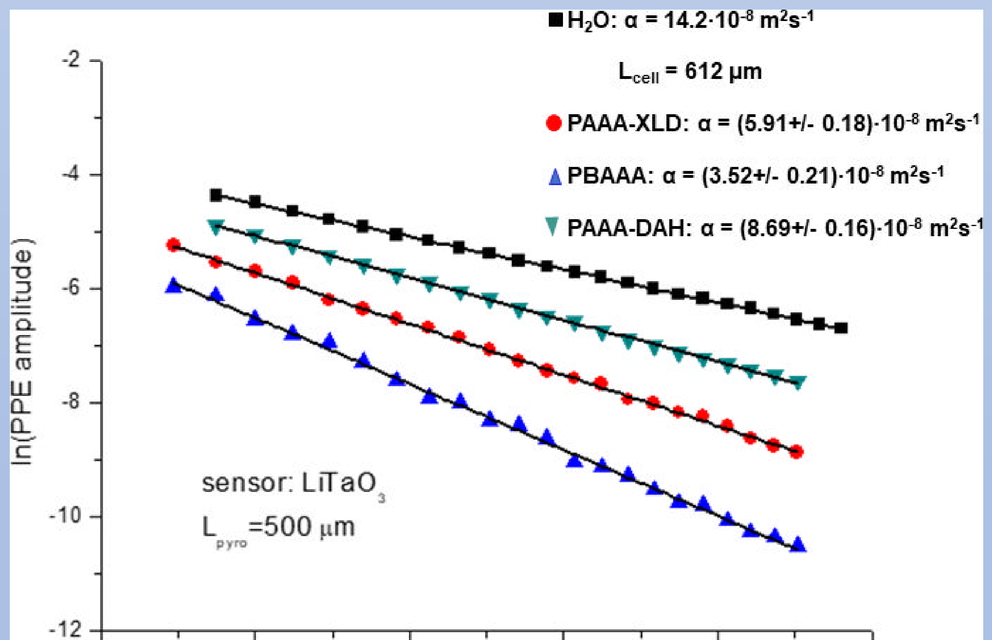


Figure 6: Photopyroelectric amplitude (logarithmic scale) as a function of sqrt. (f) for the investigated samples. The result on water is also displayed for comparison.

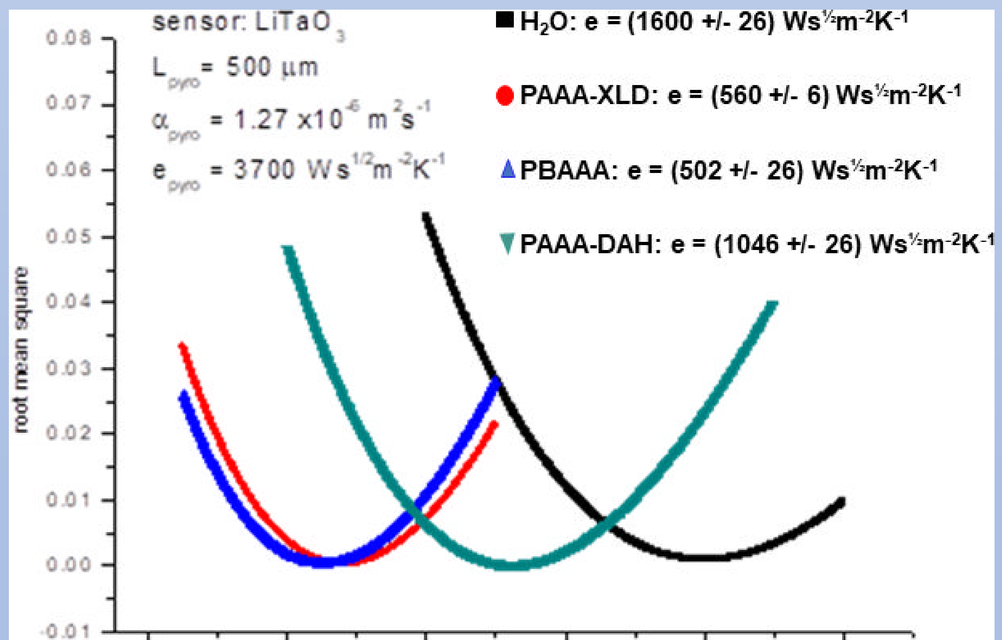


Figure 7: Root mean square as a function of the thermal effusivity for the investigated samples. The minimum of the curves indicates the value of sample's thermal effusivity. The result on water is also displayed for comparison.

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CONCLUSIONS:

❖ New class of crosslinked polymers based on poly(benzofurane-co arylacetic acid) were developed, by covalent linkage of a diamine on the polymer chain via benzofuran ring-opening.

❖ The structural investigation of the crosslinked polymers via ss-NMR and FTIR spectroscopy reveals a new class of polymers.

❖The morphology of the starting polymer and the resulting crosslinked polymers is very different, pointing out the success of the reaction between **PBAAA** and diamines.

❖ Concerning the thermal diffusivity, it is clear that **PBAAA** and **PAAA-XLD** samples are less thermal conductors than **PAAA-DAH** due to the fact that, even mixed with mineral oil, the value of their thermal diffusivity is lower than both sample **PAAA-DAH** and mineral oil, this information is useful for various applications.