Design Rules for Carbazole Derivatized n-alkyl Methacrylate Polymeric Memristors

McFarlane, T.[1], Zdyrko, B.[2], Bandera, Y.[2], Worley, D.[3], Klep O.[1], Jurča, M.[1,4], Vilčáková, J.[5], Sáha, P.[6], Tonkin, C.[7], Pfleger, J.[8] and *Foulger, S.[9]

[1]Graduate Research Assistant, Department of Materials Science and Engineering, Clemson University, [2]Research Associate, Department of Materials Science and Engineering, Clemson University, [3]Undergraduate Research Assistant, Department of Materials Science and Engineering, Clemson University, [4]Graduate Research Assistant, Centre of Polymer Systems, Tomas Bata University, Zlin, Czech Republic, [5]Associate Professor, Centre of Polymer Systems, Tomas Bata University, Zlin, Czech Republic, [6]Head of the Polymer Centre and Professor, Centre of Polymer Systems, Tomas Bata University, Zlin, Czech Republic, [7]Director of the Sonoco Institute and Chair of Graphic Communications, College of Business and Behavioral Science, Clemson University, [8]Head of Optoelectronic Materials and Properties and Professor, Otto Wichterle Centre of Polymer Materials and Technologies, Institute of Macromolecular Chemistry, Prague, Czech Republic, [9]Greg-Graniteville Endowed Chair and Professor, Department of Materials Science and Engineering, Clemson University
*foulger@clemson.edu

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Abstract: The memristor is a passive, two terminal electrical component that changes its conductivity based on its previous exposure to electric current. The polymer 2-(9H-carbazol-9-yl)ethyl methacrylate (PMAK) is one polymer that has been made into a device that shows a change in the resistance after the application of an electric field. As a voltage is applied to the material, the electroactive carbazole moieties are able to realign themselves into a confirmation that allows for the material to more efficiently transfer charge. By increasing the chain length binding the carbazole to the polymer backbone, the chain flexibility can be modified to lower the polymer's glass transition. Through this basic tenet of polymer structure properties, these methacrylate polymer systems can be altered to control the polymer flexibility and increase the number of conductive states the polymer can exhibit. Having a multitude of conductivity states allows for more intricate uses of the polymeric device including as an analog for synaptic learning behavior. In this research, methacrylate based polymers containing carbazole moieties were synthesized via free radical copolymerization of methacrylate monomers containing the respective functional group. Variations to the lengths of the side chains that are attached to the carbazole moiety to the polymer backbone were studied for their effects on the optical and electric properties of the material.