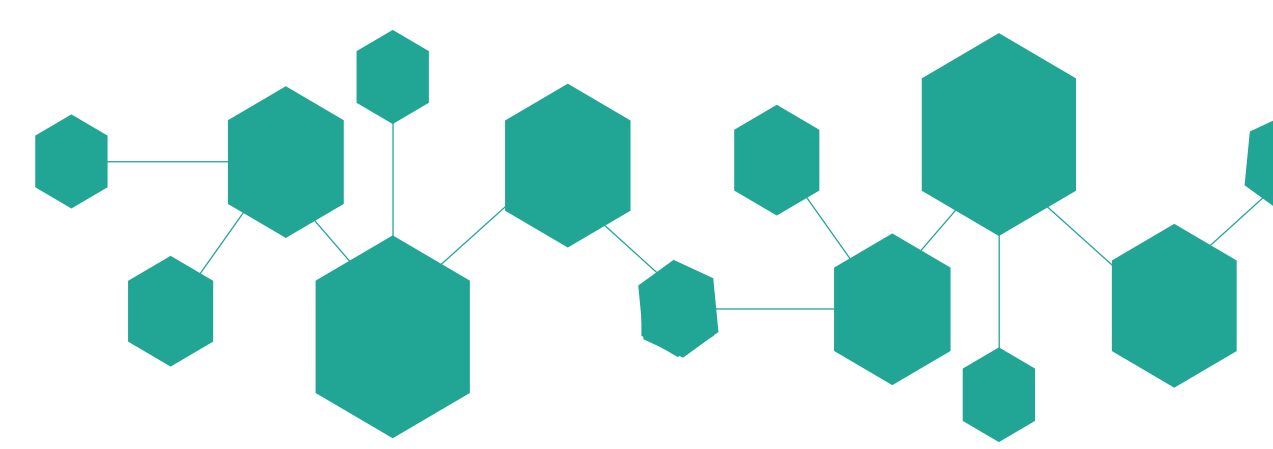




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CHEMICAL TUNING OF SPECIFIC CAPACITANCE IN FUNCTIONALIZED FLUOROGRAPHENE



Regional Centre of Advanced
Technologies and Materials

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INTRODUCTION

Supercapacitors (SCs) are the promising next generation energy storage devices, owing their rapid charge/discharge, high power and long lifetime. However, low energy density of SCs compare to batteries limits their application in several devices [1]. Graphene is considered as promising electrode material due to its high conductivity, excellent mechanical strength, large surface area and high theoretical capacitance [2]. Although, the restacking of the graphene nanosheets during electrode preparation and/or charging-discharging for large number of cycles, reduce the active sites of the electrode surface, this results in low ion diffusion that eventually reduce the capacitance and cycling stability of the graphene electrodes [3]. The covalent functionalization of graphene with suitable organic molecules is a effective strategy for bypassing the restacking of the layers. Moreover, non-agglomerated organic molecules bonded with the single sheet of graphene may enlarge the interlayer spacing which can enhance the ion diffusion and hence the electrochemical performance of the SCs.

METHODOLOGY

We developed a covalent functionalization of graphene with a zwitterionic organic moiety through the nucleophilic substitution reaction of Fluorographene (FG) with 5- aminoisophthalic acid (Niso) by adopting facile, one-step and up-scalable synthetic procedure (Fig.1). The degree of functionalization was controlled by varying the reaction time and the electrochemical performance were studied based on effect of tuning of degree of chemical functionalization [4].

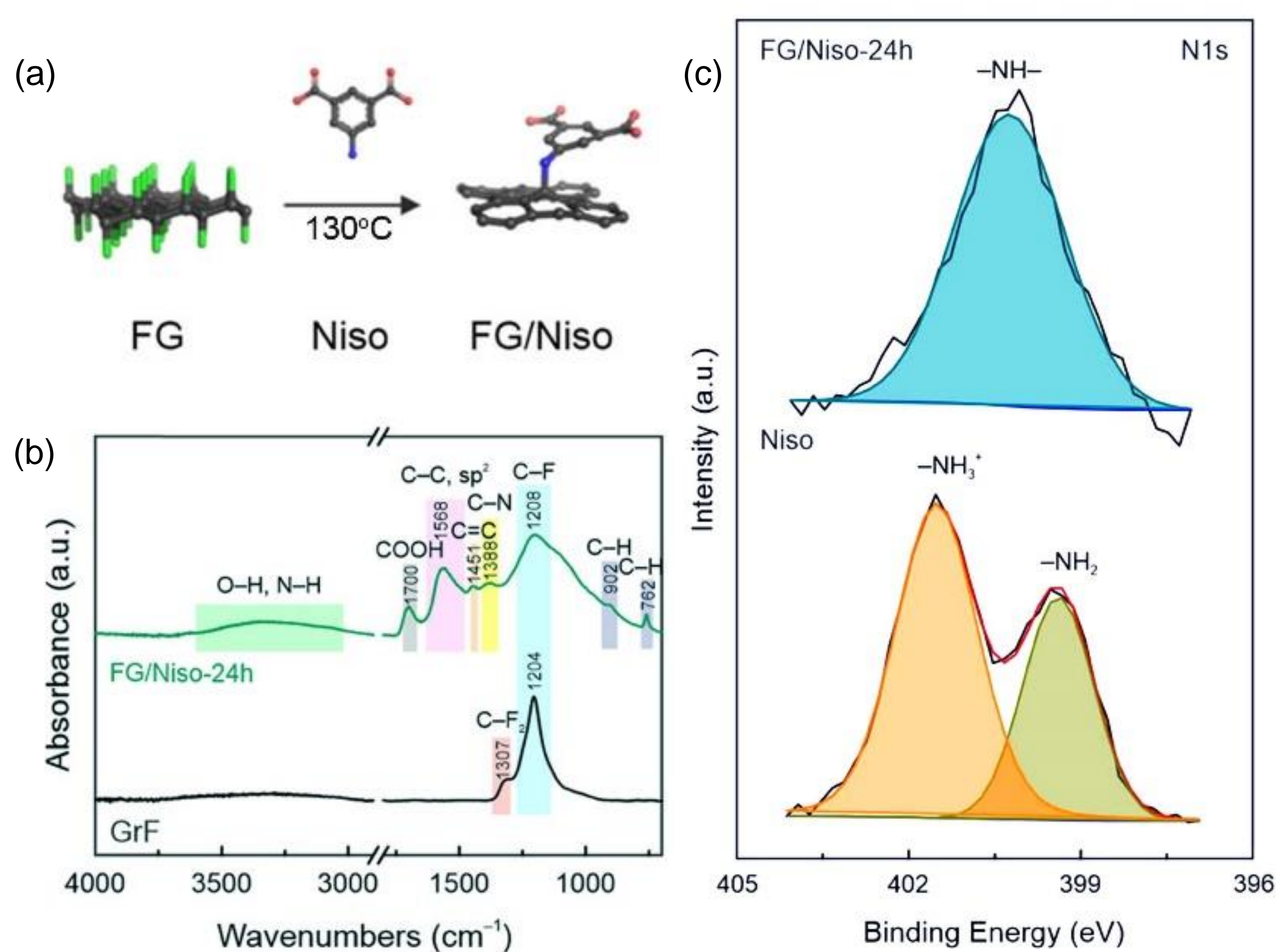


Figure 1: (a) Schematic representation of preparation of FG functionalized with Niso. (b) FTIR spectra of GrF and FG/Niso-24h. (c) Deconvoluted XPS spectra of N 1s for FG/Niso-24h and Niso [4].

RESULTS AND DISCUSSIONS

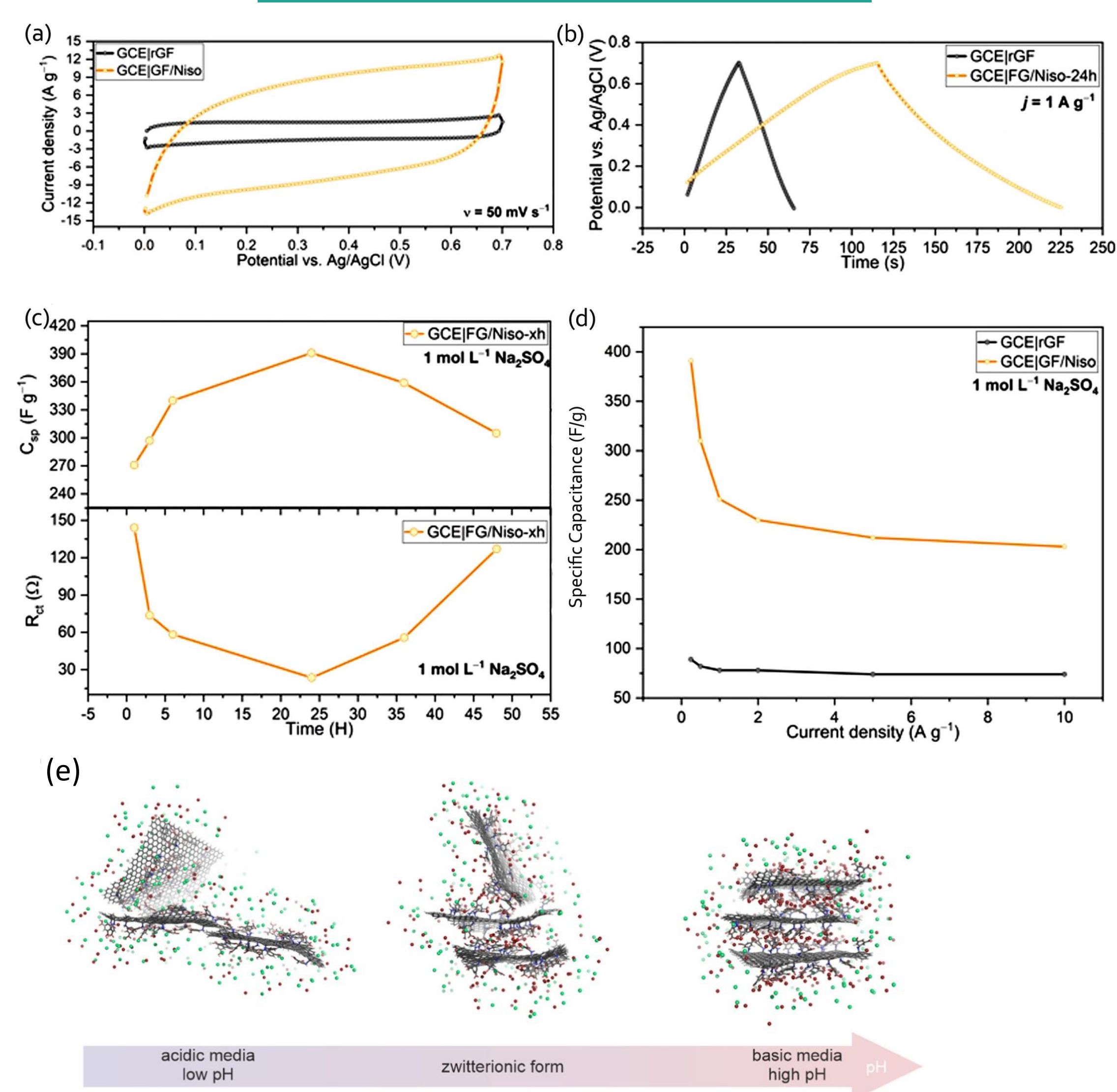


Figure 2: (a-d) Electrochemical study of FG/Niso (e) MD simulations showing changes in the packing of the structure with respect to increasing pH [4].

The functionalized graphene FG/Niso, acquired high performance than rFG. Although, the sp.capacitance is higher at certain degree of functionalization obtained by reaction time 24h with excellent rate capability. The acidic pH spread out the sheets and provide large surface area accessible for electrode-electrolyte interaction.

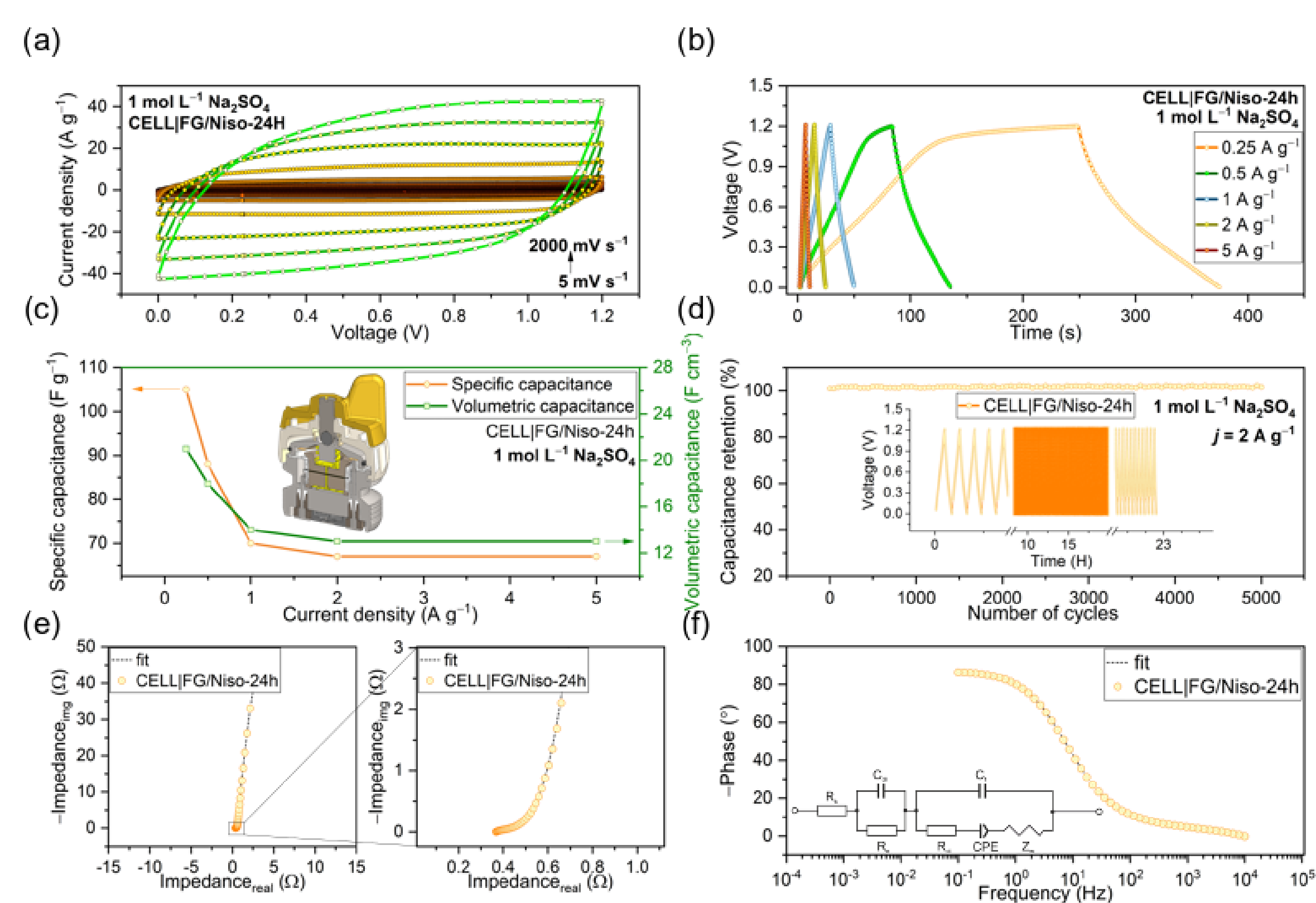


Figure 3: Electrochemical test of symmetric full cell [4]

The symmetric cell showed good ion diffusion hence the better rate performance and cycling stability. Overall, the covalently functionalized graphene derivative were studied based on degree of functionalization and the pH of electrolyte using this knowledge the electrode material were developed that showed improved sp. capacitance with good rate and stability. These findings provide important insights into the role of chemical composition on capacitance and pave the way toward designing more efficient graphene-based supercapacitor electrode materials.

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