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# Effectively Exerting the reinforcement and self-healing of Polyvinyl alcohol hydrogel nanocomposite via physically functionalized Graphene Oxide for biomedical applications

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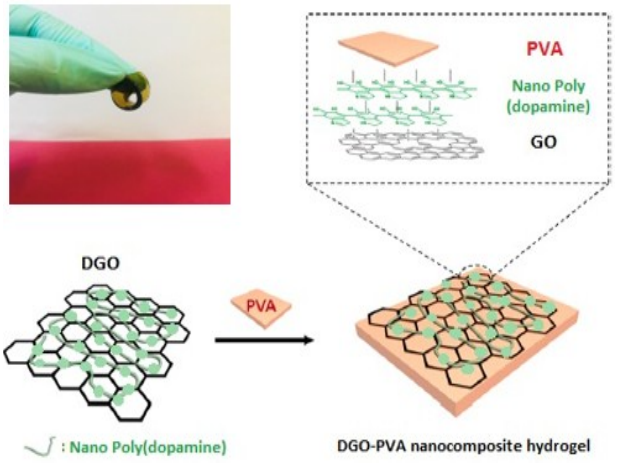
## Abstract

Hydrogels mimic native tissue micro- environment due to their porous and hydrated molecular structure [1][5]. An emerging approach to reinforce polymeric hydrogels with different nanoparticles and to include multiple functionalities focuses on incorporating nanoparticles within the hydrogel network to obtain superior properties and tailored functionality with emphasis on biomedical and pharmaceutical applications [10]. Nano Poly(dopamine)-treated graphene oxide/poly (vinyl alcohol) ("DG-O/PVA") nanocomposite hydrogels were made and characterized in this article via different tests including SEM, mechanical and self-healing test, FTIR and self-healing test. G-O was modified with Nano poly(dopamine) in aqueous solution. A combination of hydrogen bonding, strong adhesion of Nano poly(dopamine) at the interface of PVA and G-O sheets, and reinforcement by G-O resulted in increase in self-healing and mechanical properties including tensile modulus, ultimate tensile strength, and strain-to-failure by 29, 80, and 69%, respectively, at 0.75wt% DG-O loading of the PVA as a result of increased interfacial interactions between PVA, poly(dopamine) and G-O along with significant self-healing that makes it suitable to be applied as a wound dressing and drug carrier to release different types of medicine in the next step of this research.




**Keywords:** Reinforcement, Polyvinyl alcohol, Graphene Oxide, Nano poly(dopamine), Hydrogel nanocomposite, Wound dressing.

## Introduction

Hydrogels are cross-linked, three-dimensional hydrophilic polymeric networks that swell but do not dissolve when brought into contact with water and have been widely investigated as potential biomaterials for biomedical applications such as 3D-matrices for cell cultures, contact lenses, wound dressings and patches, and selective drug release and delivery systems [2][3]. They are generally formed by crosslinking of polymer chains through covalent bonds, physical entanglements, hydrogen bonding or van der Waals interactions. Within the range of polymers capable of forming hydrogels, poly (vinyl alcohol) (PVA) hydrogel has attracted great interest due to its excellent biocompatibility, low toxicity, high water content. However, the neat PVA hydrogel suffers from the poor mechanical properties (toughness and crack resistance), water-locking ability, and inferior wear resistance, which limits its development [7][11]. Integrate the hydrogel with other materials to form hydrogel composites is considered as one of the effective ways to improve the mechanical and tribological performances [4][2][3].

Recently, nanomaterials have been opening a wide window of applications due to their structural features and special properties on a nanometer scale including silica, clay and carbon-based Nano fillers [28][15][17]. To date, carbon-based Nano fillers, such as carbon black(CB), carbon nanotubes(CNTs), graphene, functionalized graphene, graphene oxide and carbon nanofibers (CNF), have been extensively used to prepare polymer nanocomposite hydrogels [20][18].

Carbon/polymer nanostructures have been studied in part due to the possibility of achieving superior mechanical, rheological and optical properties. Carbon nanotubes have been widely used as a filler in hydrogel polymer matrices, but agglomeration, the presence of catalytic impurities, and relatively high cost have presented challenges [6]. Modified Graphene has been studied as a new type of filler due in part to its potential for imparting excellent mechanical, properties in polymer nanocomposite hydrogels [19][13]. As a new kind of carbon material, graphene, a single-layered and two-dimensional lattice, was first reported in 2004 and has been widely investigated because of its unique mechanical, quantum and electrical properties [27]. Graphene