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A new heterogenous catalyst supported on graphene oxide for the selective epoxidation of olefins

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Abstract
Graphene-based nanomaterials, specifically graphene oxide (GO) due to unique properties and oxygenated functional groups on basal and edges of nanosheets, are ideal candidates as solid support for the immobilization of various homogeneous catalysts [1-2]. Recently, click chemistry has been employed in several processes such as functionalization of solid surfaces, immobilization of homogeneous catalysts, and preparation of polymer-based hybrid materials [3-4]. In this study, a new heterogeneous catalyst was synthesized via a click chemistry approach. The surface of graphene oxide (GO) was modified by cysteamine hydrochloride as linking agent. Then, the Venturello catalyst (PW) was supported on the surface of clicked graphene oxide through the electrostatic interaction with ammonium groups. A schematic description of the heterogenous catalyst preparation is depicted in Figure1. The catalytic performance of the prepared catalyst was investigated in the epoxidation of olefins and allylic alcohols using H_2O_2 as oxidant. The results showed that the catalyst could be reused for five runs without significant loss of activity and stability.

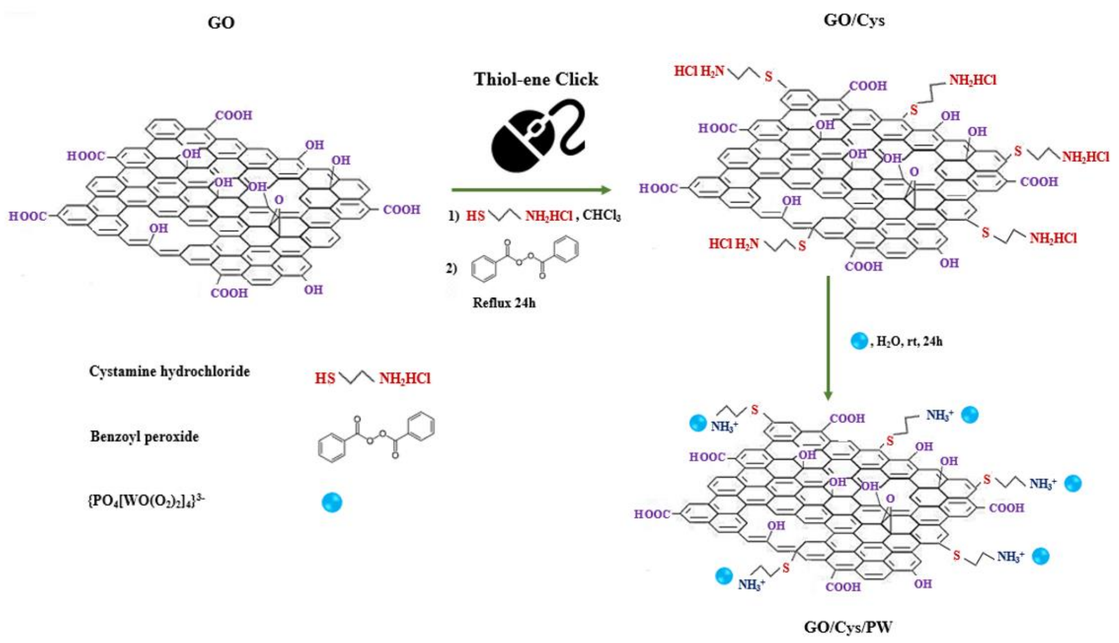
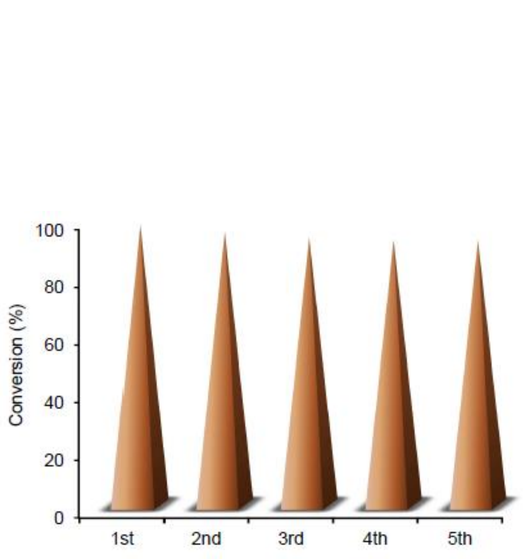
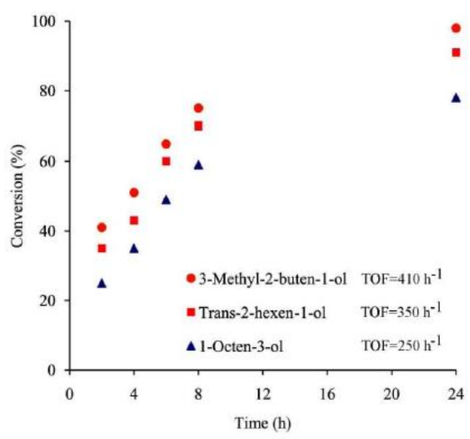


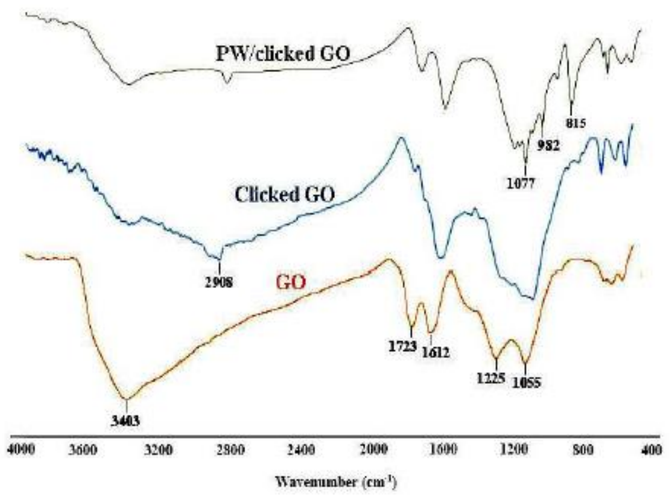
Figure 1: Schematic illustration for the preparation of the heterogenous catalyst.

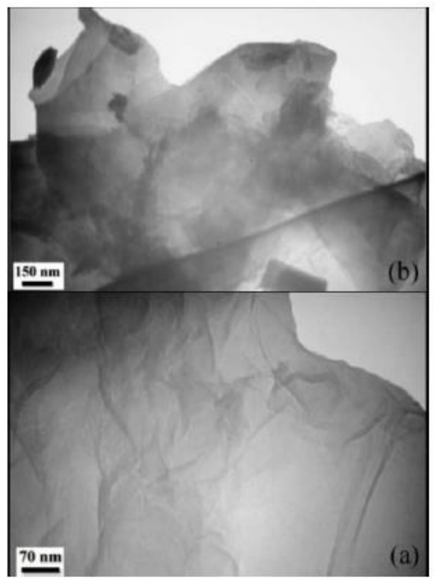
Experimental

The obtained clicked GO (1 g) was dispersed in 50 ml of deionized water using ultrasonication and subsequently PW (2 mmol) was added into the suspension and stirred for 6 h at room temperature. The prepared material was extracted thoroughly with deionized water in a soxhlet apparatus to remove unreacted PW species and then dried under vacuum at 80°C to obtain PW/clicked GO.









Conclusion

Clicked GO was synthesized via thiol-ene click reaction and utilized as support for the immobilization of Venturello anion. Characterization results such as FT-IR and ICP-OES spectroscopies demonstrated that Venturello anion was successfully immobilized onto the surface of GO via electrostatic interaction and the layered structure of GO preserved during the chemical modifications. TGA analyses showed that due to the immobilization of Venturello anion, the thermal stability of the GO was improved. The utilization of the prepared hybrid nanomaterial as heterogeneous catalyst was explored in the epoxidation of olefins and allylic alcohols using H2O2 which showed high catalytic performance (in terms of TOFs) and reusability after five runs without significant loss of activity and selectivity.

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