Functional Materials

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Investigation of antioxidant activities of some flavonoid derivatives using aminophenyl modified glassy carbon sensor electrode

I.E. Mülazımoğlu[1], A. Demir Mülazımoğlu[1], E. Yılmaz[1]

[1]Necmettin Erbakan University, Chemistry, Konya, Turkey

iemulazimoglu@konya.edu.tr
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Carrying on its development in the last 20 years and having quite a significant place in electrochemical studies, the modification of electrodes are extensively used today. Therefore, these modified electrodes come to the fore in determination of organic and inorganic species, especially in the determination of species that are of very little amount in natural samples. Modified electrodes can be prepared through appropriate media of an electrode surface and through electrochemical oxidation or reduction under the optimum conditions [1, 2], and they can also be physically prepared as in carbon paste electrodes [3]. Although the electrode modification is made in the aqueous medium [4, 5], there are recent studies in non-aqueous medium [6]. Because appointments are usually made in the aquatic environment during the studies, when thought to be more stable, aqueous media modification processes are preferred. However, determinations of some species in natural samples, such as phenolic compounds [3, 6], metals [7, 8], etc. can also be made in the aqueous medium using the sensor electrodes obtained after modification in the aqueous medium.

The electrochemical behaviors of 10 structurally different flavonoids (quercetin, galangin, chrysin, 3-hydroxyflavone, naringenin, luteolin, apigenin, flavone, kaempferol, and naringin) on a glassy carbon electrode (GCE) were studied by cyclic voltammetry. In the current study, nitrophenyl (NP) diazonium salt has been synthesized from p-nitrophenylamine. One millimolar prepared NP diazonium salt (in 100 mM tetrabutylammonium tetrafluoroborate) in acetonitrile was used to modify the glassy carbon electrode. Nitro groups have been reduced to amine groups in 100 mM HCl medium on the NP modified GCE surface. Although NP-modified GCE surface was electro-inactive, it is activated by reducing the nitro group into amine group. And then, aminophenyl (AP) modified GCE surface has been used for the determination of antioxidant activities of 10 flavonoid derivatives with cyclic voltammetry technique.

The aim of this work were: (a) to electrochemically modify GCE in non-aqueous media, (b) to characterize NP modified GCE electrode (NP/GCE), AP modified GCE electrode (AP/GCE), and flavonoid-grafted AP/GCE sensor electrodes in various medium by cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), and scanning electron microscopy (SEM), (c) to investigate the effect of sweeping rate, and (d) to investigate the interaction of this modified electrode with some flavonoid derivatives by CV. AP/GCE sensor electrode has been used to examine its sensitivity against quercetin, galangin, chrysin, 3-hydroxyflavone, naringenin, luteolin, apigenin, flavone, kaempferol, and naringin by using the CV technique.

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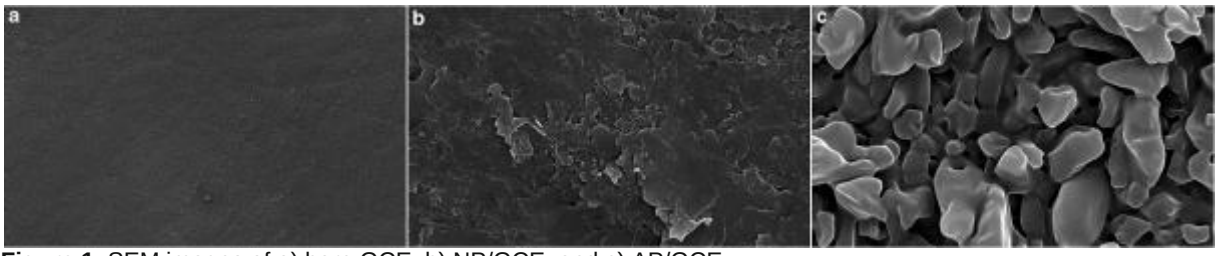

Figure 1. SEM images of a) bare GCE, b) NP/GCE, and c) AP/GCE