Anion-sensitive coated wire electrode based on a hardener in epoxy resin

T. Honjo and S. Hata

Department of Chemistry, Kanazawa University,
Kanazawa 920, Japan

Anionen-sensitive Drahtelektrode mit gehärtetem Epoxyharz-Überzug

It has been found that a copper wire coated with epoxy resin (Luveak-812) hardened with didoceny succinic anhydride (Luveak-DDSA, hardener) in the presence of 2,4,6-tri(dimethylaminomethyl) phenol (Luveak-DMP-30, accelerator) and with polyamide (Araldite, hardener) functions effectively as a sensor for anions such as nitrate, chloride, bromide, iodide, perchlorate, and sulfate in the range of 10^{-6} to 10^{-1} mol/l.

Experimental

The top part (1–1.5 cm in length) of a fine copper wire (1.0 mm in diameter) of co-axial cable (7.0 mm in diameter, 8–10 cm in length) was coated with epoxy resin hardened with 50% of Luveak-DDSA in the presence of 2.5% Luveak-DMP-30 and with 50% of polyamide each. The electrodes were allowed to stand for 2–3 days at room temperature (20–25°C), as previously described [1–3]. The remainder of the exposed wire was wrapped tightly with Sealon film (Fuji Photo Film Co., Ltd) in order to prevent direct contact of the metal surface with the test solution. A model M-7_{II} Hitachi-Horiba pH-meter equipped with a model 2010A Ag/AgCl reference electrode (pinhole type) was used to make the potential measurement. The coated-wire electrode prepared in this manner (Fig. 1) was soaked in deionized water for 20–30 min before measurement.

This electrode gave potential responses to changes in ion activities of anions such as nitrate, chloride, bromide, iodide, perchlorate, and sulfate when placed in each solution within 1 min. A copper wire electrode coated with a mixture of epoxy resin containing 60% of hardener such as ethylenediamine, diethylenetriamine, and triethylenetetramine each, gave no potential responses for any anions. The coated-wire electrode can be stored in air and is stable a month or longer. The potential

Fig. 1. Anion-sensitive coated wire electrode

of the electrode changes from -100 to $+200$ mV in the range of 10^{-6} to 10^{-1} mol anions. The electrode with Luveak-DDSA containing Luveak-DMP-30 gave a somewhat higher potential than that with Araldite. The pH-range for effective use of the electrode was 5–12, giving a constant potential. The response of the electrode is linear in the range of 10^{-5} to 10^{-1} mol/l anion, with a nearly Nernstian slope of about 40–70 mV per activity as shown in Table 1.

The potential responses of this electrode were not specific for the anions investigated, however it may be useful as multisensor for these anions.

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Table 1. Behaviour of anion-sensitive coated wire electrode based on a hardener in epoxy resin at 20°C

Anion	Slope mV/-log a		Concentration range of linear response (mol/l)		Useful concentration range (mol/l)	
	DDSA-DMP	Araldite	DDSA-DMP	Araldite	DDSA-DMP	Araldite
Nitrate	56	68	10^{-5} – 10^{-1}	10^{-4} – 10^{-1}	10^{-6} – 10^{-1}	10^{-6} – 10^{-1}
Chloride	56	56	10^{-4} – 10^{-1}	10^{-4} – 10^{-1}	10^{-6} – 10^{-1}	10^{-6} – 10^{-1}
Bromide	60	62	10^{-4} – 10^{-1}	10^{-4} – 10^{-1}	10^{-6} – 10^{-1}	10^{-6} – 10^{-1}
Iodide	62	68	10^{-5} – 10^{-1}	10^{-4} – 10^{-1}	10^{-6} – 10^{-1}	10^{-6} – 10^{-1}
Perchlorate	70	^a	10^{-5} – 10^{-2}	^a	10^{-6} – 10^{-2}	10^{-5} – 10^{-2}
Sulfate	40	^a	10^{-3} – 10^{-2}	^a	10^{-6} – 10^{-1}	10^{-6} – 10^{-2}

^a Linear response was not observed. The selectivity of these electrodes for nitrate generally increased in the order of chloride < bromide < iodide, perchlorate for each foreign ion

Offprint requests to: T. Honjo

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