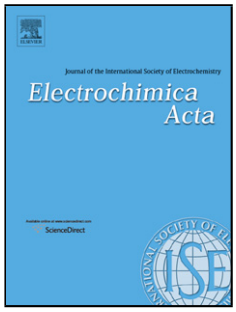

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The continued development of reticulated vitreous carbon as a versatile electrode material: structure, properties and applications

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Abstract

The limitations of 2-dimensional electrodes can be overcome by using three-dimensional materials having sufficient porosity and active area while offering moderate mass transport rates and a relatively low pressure drop at controlled electrolyte flow rate. In concept, a wide variety of metal, ceramic and composite materials are possible but restrictions are imposed by the need to avoid materials degradation, while maintaining adequate electrical conductivity, sufficient robustness and the possibility of facile scale-up. Despite its fragility, one of the traditional electrode materials used as a porous, 3-dimensional electrode is carbon foam, particularly in the 97% vol. porous form of reticulated vitreous carbon, RVC. A time-line indicates that the history of this material dates back over 50 years to the mid-1960s, when it was primarily used as an uncoated material in small-scale, laboratory electroanalysis. Surface modification and diverse coatings have considerably extended the use of RVC. Recent applications are found in sensors and monitors, electrosynthesis, environmental processing and energy conversion. This review highlights the fundamental structure and summarises the physicochemical properties of RVC. Fluid flow through various porosity grades of the material, their active electrochemical area and rates of mass transport are quantified. The diverse applications of RVC in energy conversion, environmental treatment and electrosynthesis are illustrated by selected examples from the authors' laboratories and others over the last 30 years. Recent research on coated RVC, energy conversion environmental remediation and sensors is highlighted. Critical areas deserving further research and development are proposed.

Keywords: area, energy, foam, mass transport, porosity, structure, three-dimensional.

(Approx. 18.700 words, 18 reactions/equations. 4 tables, 20 figures and 160 refs.).