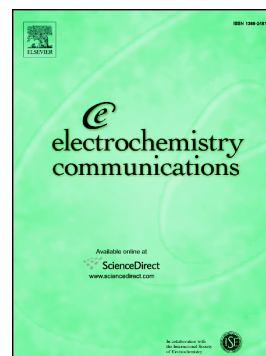


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**Combination of microspheres and sol-gel electrophoresis for the formation of
large-area ordered macroporous SiO₂**

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ABSTRACT

A simple and effective fabrication scheme involving sequential electrophoretic depositions of polystyrene (PS) microspheres (500 nm and 1 μm in diameter) and SiO₂ sols (~ 5 nm in diameter) to produce large-area ordered macroporous SiO₂ inverse opals (2×2 cm²) on ITO substrates is demonstrated. The zeta potentials for PS microsphere suspension and SiO₂ sols are measured to determine an optimized processing window in which both samples carry negative surface charges and sol-gel transformation can be properly implemented. Our approach entails the electrophoresis of PS microspheres to render a colloidal crystal with negligible defects. Afterward, SiO₂ sols are infiltrated to the interstitial voids among the closely-packed PS microspheres via another electrophoresis process, followed by an oxidation treatment to remove the PS colloidal template and complete the densification of SiO₂ gels. The resulting SiO₂ inverse opals reveal impressive surface uniformity and structural integrity. Fourier transform infrared spectroscopy confirms the complete removal of PS microspheres, leaving an intact SiO₂ skeleton, whereas X-ray diffraction pattern indicates its amorphous nature.

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