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Electrical response during drying and imbibition of mesoporous materials.

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Upon the contact of the conductive mesoporous material with an aqueous electrolyte solution, ions adsorb on its surface, spontaneously forming an electrical double layer. In this case, due to the absence of an applied external potential difference, while the total charge of the system is zero, there is already accumulated a local charge at the interface. The number of adsorbed ions is determined by the chemical composition of the material, the bonds on the surface and, due to the spontaneity of this process, to a large extent by the surface area. Therefore, mesoporous materials with high specific surface area and porosity become the most favorable objects for research. However, when a second electrode with a different surface chemistry is introduced into the circuit, a potential difference occurs. This leads to spontaneous charge redistribution between the electrodes and rearrangement of ions at the interface. Current relaxation and potential difference evolution are the key characteristics of this process. Changes in the imbibition parameters as well as decreasing of wetted surface area during drying affect these electrical responses. Here we investigate the nature of these electrochemical processes and their correlation with fluid dynamics using gravimetric mass uptake measurements in combination with Zero Resistance Amperometry and other Open circuit methods.

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