Active carbon honeycomb monoliths derived from brown coal and their application for gas and liquid adsorption

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Electrically conductive parallel channel ‘honeycomb monolith’ (HM) carbons have been prepared directly from brown coal by a new efficient approach. Kneading the coal into a plasticine consistency enables it to be extruded in HM form such that it can be dried, carbonized and activated, retaining its structural integrity throughout these steps.

Soft brown coal, which inherently contains relatively high oxygen functional group concentrations and high moisture contents, develops a strong H-bonding network during kneading. This holds it together during subsequent fabrications steps, to provide HM carbons with excellent and tailorable properties: e.g., compressive strength (40-250 MPa), electrical conductivity (100-500 $\Omega^{-1}cm^{-1}$), surface area (800-1200 m^2/g). HM carbons can be fabricated with various cell densities (470 cells/cm^2 is typical) and their low production cost makes them attractive for a wide variety of applications in adsorption, catalysis, etc.

HM carbons proffer a number of advantages over conventional powdered or granular analogues. The pressure drop across a ‘fixed bed’ is substantially reduced enabling higher throughput. The conductivity of the monoliths facilitates their facile regeneration by application of an electrical current to the monolith. This is referred to as electrical swing adsorption (ESA) or electrical swing regeneration (ESR).

The monoliths’ performance is being investigated across a range of adsorption applications in both the gas-phase (e.g., carbon dioxide, methane, hydrogen, formaldehyde) and liquid-phase (e.g., phenol, dyes, humic substances, phosphorous). The presentation will detail the behavior of a number of examples from these lists, in terms of adsorption capacity, adsorption kinetics and adsorbent regenerability.