Carbon products from lignite:  
Monoliths, fibres, cokes, bitumens, quantum dots, and more

Alan L Chaffee

*School of Chemistry, 17 Rainforest Walk  
Monash University, VIC 3800, Australia*

Victorian lignite (VL) exists in massive deposits that are very accessible via open cut mining and has provided most of the state’s energy needs for decades. Although ~20 million years old, it is really just plant remains (wood, leaves, resins, etc) that have not altered all that much since its original deposition. Plant remains (wood, leaves, resins, seeds) can be readily distinguished macroscopically amongst the groundmass, and microscopically using petrographic techniques.

VL has very low N and S levels and also, importantly, inherently low levels of inorganic matter, rendering it far ‘cleaner’ than most conventional biomass. These characteristics make VL a desirable carbon precursor from which the manufacture of a variety of high-value products, as mentioned in the title, can be considered.

Kneading the soft VL into a plasticine consistency enables it to be extruded into a ‘honeycomb monolith’ (HM) form, then dried, carbonized and activated, with retention of its structural integrity. HM carbons with tailorable properties (variable compressive strength, electrical conductivity, surface area) can be fabricated at various cell densities (470 cells/cm2 is typical). It is the nanostructure of these materials that controls their behavior and utility.

Their low production cost makes them attractive for a wide variety of applications in adsorption, catalysis, etc. They also proffer a number of advantages such as a low pressure drop across a ‘fixed bed’ enabling higher throughput and electrical continuity which enables them to be regenerated via an ‘electrical swing’.

The HM performance is progressively 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).