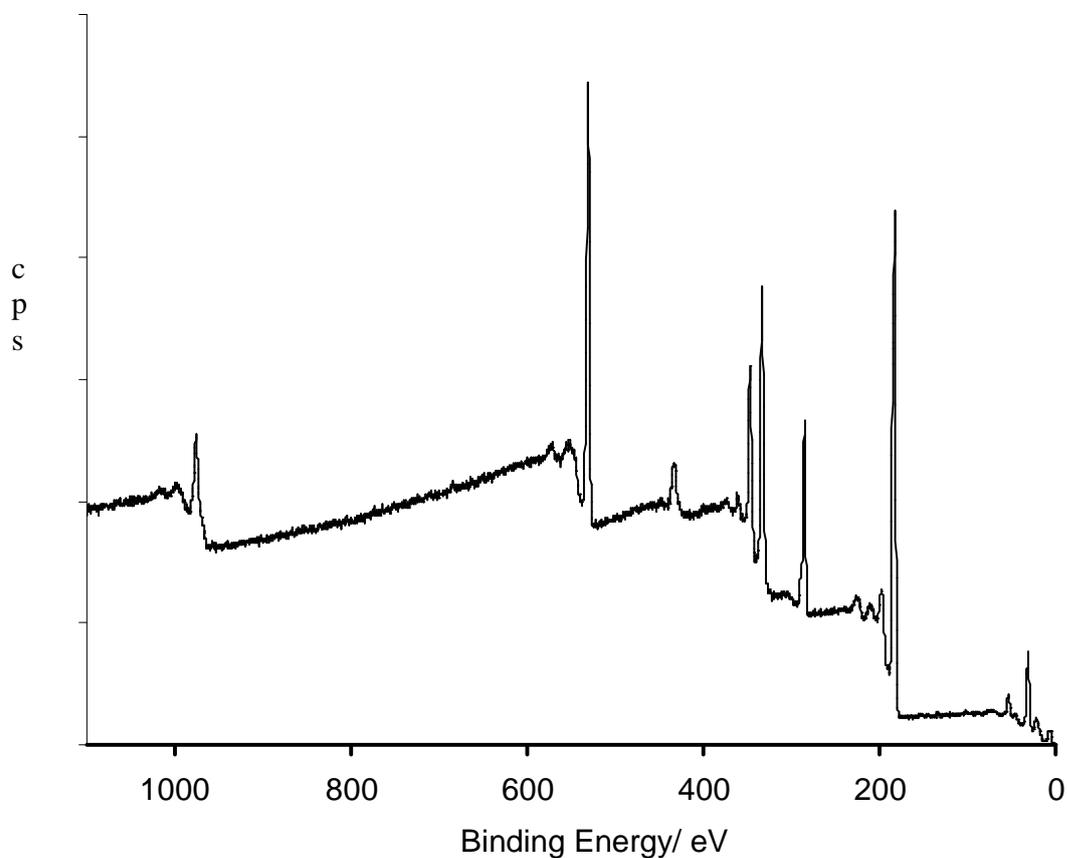
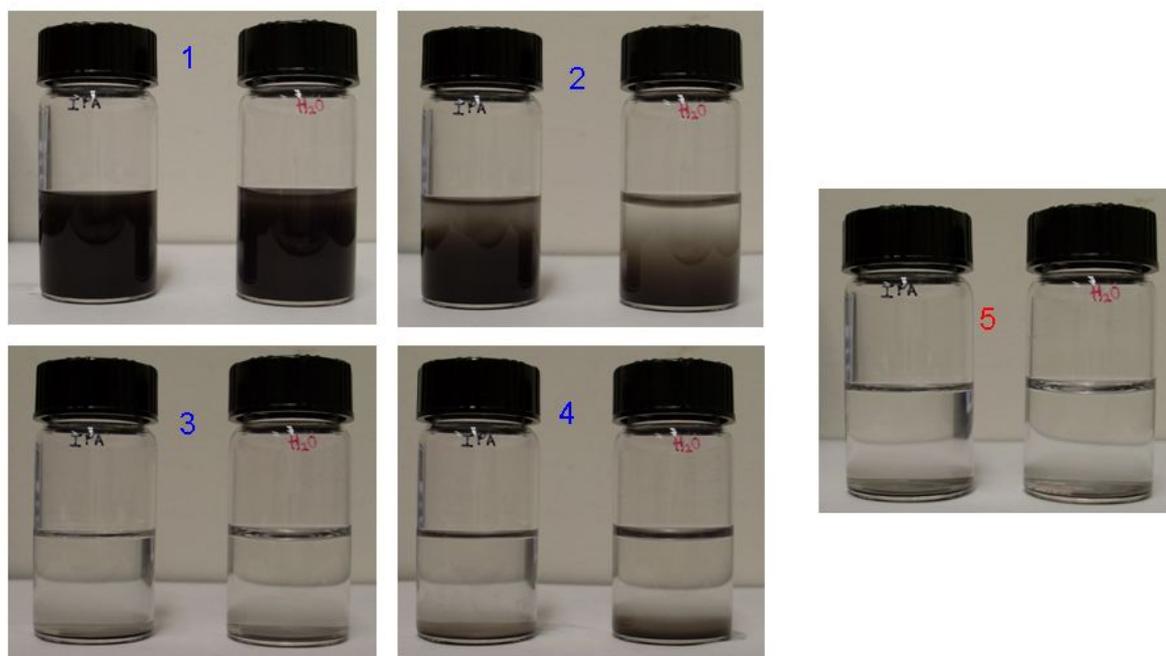


Supplementary Fig. 1: An overview of carbon clad zirconia particles (top), two times sulfonated carbon clad zirconia particles (bottom). Different batches do not differ in morphology in carbon or sulfur content. No breakage or change in morphology can be seen for particles which go through 2 x sulfonation (2 hour stirring) and a stringent washing procedure with various solvents and 1% wt/wt NaOH.



Supplementary Fig. 2 XPS spectrum of the unmodified carbon clad zirconia (raw material for the column 75-111)

Peak Positions	O 1s	N 1s	C 1s	Zr 3d	S 2p
Position Binding Energy (eV)	530.53	400.68	285.18	182.63	168.98
Scofield Rel. Sensitivity Factors	0.780	0.477	0.278	2.576	0.668



Supplementary Fig. 3 Sedimentation behaviour of sulfonated 3 μ m CCZ in water and isopropyl alcohol (batch 75-112): (1) Freshly sonicated slurry of 1xsulfonated carbon clad zirconia in 2-isopropanol (IPA) and water. (2) After 20 minutes, settling is faster in water (3) After 9 hours (4) Brief simultaneous sonication of both vials shows that the sediment is easily disturbed in water (5) Slurry when allowed to sit for 12 hours after sonication. Note that with zirconia core high density, it eventually settles quickly (~ 5 specific gravity), suggesting that balanced density method of packing may not be feasible.