Preparation of a stable colloidal MXene dispersion in high salinity solution by grafting polyelectrolyte stabilizers

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There has been much effort in exploiting nanotechnology in various subsurface applications. One of the important challenges in such applications is to maintain the colloidal stability of nanomaterials in high salinity conditions of subsurface media. Here, we consider 2D titanium carbide (Ti_3C_2-MXenes) nanosheets as an effective scavenger of various aqueous pollutants. It was found that pristine MXenes were not stable in high salinity solutions containing both mono and divalent salts, likely due to the charge screening effects in high ionic strength and bridging effects caused by excess divalent cations. We prepared a stable colloidal dispersion of MXenes in high salinity solution, by grafting polyelectrolyte stabilizers. It was found that MXenes grafted with both anionic and zwitterionic copolymers showed excellent colloidal stability in standard American Petroleum Institute (API) brine (8% NaCl+2% $CaCl_2$ by wt%) over four weeks. With respect to the long term stability over several months, MXenes grafted with the zwitterionic copolymers exhibited much slower sedimentation than those grafted with the anionic copolymers – possible mechanisms are discussed.