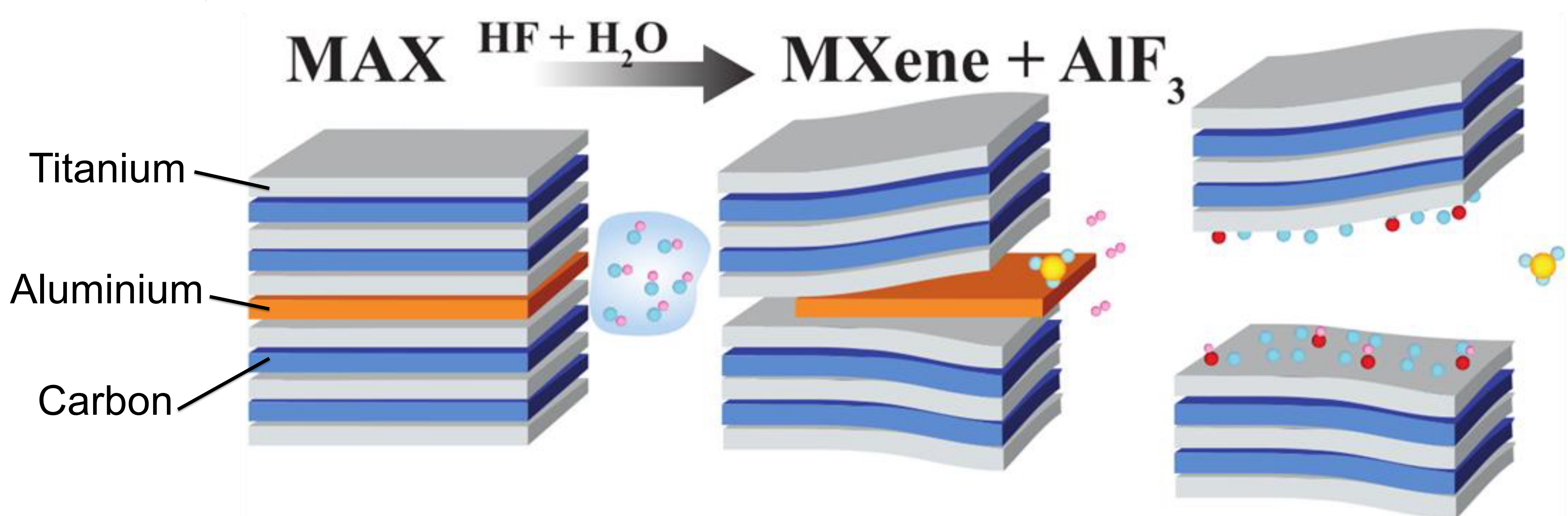


How will large-scale manufacturing of MXenes impact the environment?

BACKGROUND

MXenes are two-dimensional advanced materials that are an important focus of nanomaterials research. To date, no environmental assessment of its potential future production has been performed. Here, a prospective cradle-to-gate life cycle assessment (LCA) of large-scale manufacturing of a Ti_3C_2 MXene is presented with the goal to pinpoint hotspots. The production route considered is HF etching, shown in the figure below. A so-called MAX phase (Ti_3AlC_2) is treated with hydrofluoric (HF) acid, water, and then delaminated with lithium chloride (LiCl), giving aluminium fluoride (AlF_3) as byproduct. Main inputs to the MAX phase production are titanium, aluminium, and carbon. Data was obtained from a scalable synthesis description currently used in small-scale commercial production, which was scaled up using process calculations.



RESULTS

Preliminary relative results per kg Ti_3C_2 MXene below show that titanium powder production is the main hotspot for all impact categories. Reducing impacts from titanium powder production and increasing the share of recycled titanium are therefore the main recommendations. The future electricity supply did not influence contribution results notably.

