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C3Po1D-04: Development of quick connect liquid hydrogen coupler utilizing 3D printing

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Liquid hydrogen couplers currently under development require extensive purging, are cumbersome to handle, and cost prohibitive. Our hypothesis is that by combining cryogenically conformable polymer gaskets with 3D printed metal alloys, we can create a coupler that enables purge-less connecting and disconnecting of liquid hydrogen transfer lines at a reduced weight and cost. We recently demonstrated fully collapsible polymeric fuel bladders and novel conformable seats for pressure relief valves at cryogenic temperatures. This conformable polymer advance can be adapted for use in quick-connect coupler valve seats. Concurrently, 3D printed metal alloys are disrupting what is possible for cryogenic materials. We have identified 3D printed aluminum alloys with properties comparable to stainless steel at 20 K with 1/3 the density. These technologies can not only reduce weight and cost but mitigate thermal and mass leakage that are common with conventional LH2 couplers.

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