Advanced gas-solid chemical looping reactors for cost-effective production of clean chemicals

Abstract

Gas-solid reactions have been proposed in the last decades for several applications in the energy and chemical industries.

Chemical looping is based on an oxygen carriers (Fe, Ni, Cu, Mn oxides are the most common elements studied) that is alternatively oxidised in presence of air to form metal oxide and reduced in presence of fuel gases to form pure CO_2 and H_2O. As a result, an unmixed combustion is occurring, thus pure CO_2 is generated as in the case of oxy-combustion technology. In case of sub-stoichiometric oxygen content, the process can also operate as partial oxidation or reforming.

The development of advanced solid looping processes implies research on material development, reactor engineering, flowsheet optimisation. Most of the challenges associated with gas-solid reactions are related to the components lifetime, heat management and costing. As novel and advanced CO_2 capture technologies, they have overcome technological and market barriers in view of the fact that other technologies like amine-based CO_2 absorption unit are well established and commercially available.

An overview of recent developments in the scale up of chemical looping for hydrogen and chemicals production is presented including new opportunities to explore market opportunities and industrial decarbonisation.

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RESEARCH PROFILE SUMMARY

Dr Vincenzo Spallina is a Senior Lecturer in the Department of Chemical Engineering with expertise in the field of fuel cells, membrane/membrane reactors and gas-solid technologies. His research combines experimental activity, modelling and technology assessment for low-carbon energy, biofuels and CCUS.

He has been awarded a total of 6 research grants totalling over £2.7M as PI or co-PI for different funding sources including industry (Argent Energy, British Steel, Total Energies), UK-based sources (EPSRC, Innovate UK), European Commission (H2020) and BEIS.

He has published 50+ academic papers (Citations: 1100+; h-index: 21). He is currently the project coordinator and PI of an EU-H2020 project on negative emissions aviation biofuels (H2020 GLAMOUR), PI of an EPSRC project (EP/S030654/1) within the EPSRC CREDS program, Co-I in an H2020 project (H2020 C4U), EPSRC (EP/V026089/1), INNOVATE UK (code 113237).

He holds a BSc (2005) and MSc (2008) in Energy Engineering and a PhD cum laude in 2013 in Nuclear and Energy Science and Technology program from Politecnico of Milan (IT) working in the group of Energy Conversion System (GECoS). Before joining the University of Manchester as Lecturer, he spent 4 years as postdoc in the group of Chemical Process Intensification at the TU Eindhoven and 6 months as researcher at Tecnalia Research Centre in the group of Membrane technology. At the University of Manchester, he is also the academic lead of the James Chadwick Building.