

Team achieves more efficient gas separations using new polymer that selectively sieves gas molecules

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A new polymer developed by researchers at Cardiff University may lead to more efficient large-scale separation of gas mixtures for chemical engineering and energy generation.

[Gas separation](#) is crucial for many [industrial processes](#) including obtaining nitrogen or oxygen from air and purifying natural gas or hydrogen. Currently, the most energy efficient method for separating gases involves polymer membranes, however, most polymers either let gases pass through slowly (i.e. have low permeability) or are not selective towards one gas over another. Gas separation would be cheaper and use less energy if polymer membranes could be made both highly permeable and selective.

A team from the University's School of Chemistry reports in the journal *Science* a new polymer that efficiently separates gas mixtures based on the different sizes of the [gas molecules](#). The polymer's molecular structure is very contorted so that it cannot fill space efficiently, therefore leaving gaps for small gas molecules to move through quickly. However, the transport of larger gas molecules is hindered by the polymer's extreme rigidity so that it acts as an efficient molecular sieve.

The Cardiff's team's collaborators at the Institute on [Membrane Technology](#), ITM-CNR, Italy, confirmed that membranes prepared from the polymer are both highly permeable to gases and demonstrate

remarkable selectivity for smaller gases such as hydrogen or oxygen over larger gases such as nitrogen or methane.

Professor Neil McKeown, a member of the School of Chemistry's team behind the research said: "The preparation of this highly rigid and contorted polymer required us to develop a new polymerisation reaction. In fact we used some very old chemistry – the formation of Tröger's base, which is a compound that was first prepared 125 years ago. This simple chemistry allows us to prepare highly rigid ladder polymers of high [molecular mass](#) from readily available starting materials. In addition to making polymers for efficient gas separation membranes, we anticipate that this new process will be useful for preparing polymers for a variety of different applications".

Cardiff University has applied for a patent covering this new polymerisation process.

More information: "An Efficient Polymer Molecular Sieve for Membrane Gas Separations," by M. Carta et al. *Science*, 2013.

Provided by Cardiff University

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