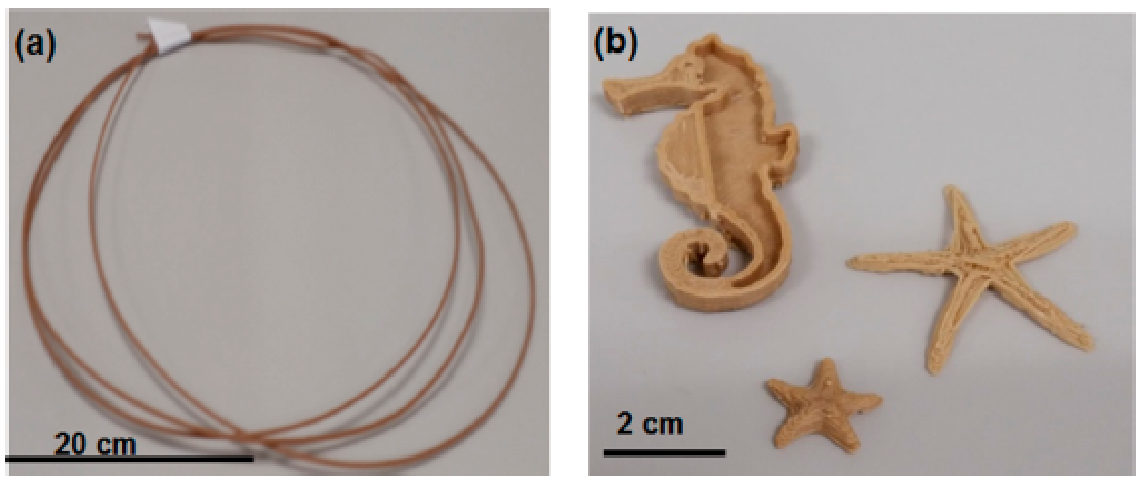
Making new functional polymers for 3-D printers

October 19 2016, by Anne Rahilly



New directions in 3D technology- filaments produced by hot-melt extrusion. Credit: University of Melbourne

Chemical engineers at the University of Melbourne have found a way to 3-D print smart polymers (or plastics) that can perform a function, in a way that is cheaper, cleaner and more accessible than ever before.

These smart and functional polymers that are being produced by Dr Luke Connal and his team from the Department of Chemical and Biomolecular Engineering are not the inert objects, we are used to associating with 3-D printed objects, but are built to undertake a chemical reaction, so that they can perform a function in a particular environment.

One example, of an application for such an object could be to clean up environmental toxins.

"We have developed interesting materials that can be printed on the more affordable range of 3-D printers, like the ones you can buy in hardware shops these days," said Dr Connal.

"Basically we are trying to add function to these 3-D printed objects. Rather than just having a inanimate printed object, we are creating something that you can do something else with," he said.

In the paper "Three Dimensional Printing of pH-Responsive and Functional Polymers on an Affordable Desktop Printer," published in *ACS Applied Materials & Interfaces* this week, Connal and PhD students Milena Nadgorny, Chao Chen and PostDoc Fellow Dr. Zeyun Xiao, outline other potential areas for future applications of these new materials.

One such example is accelerating a chemical reaction by adding a catalyst for treatment of environmental pollutants and flow control

PhD student Milena Nadgorny brings her expertise in inkjet printing to the research. Her previous studies in chemical engineering and materials science, blended with industry experience working with HP, have allowed her to tackle some of the problems she has encountered with this research in a multidisciplinary way.

"We dreamt this up and Milena started it. Our expertise is making polymers. We saw the opportunity to make polymers that change shape or change properties with a trigger and we set out to develop methods to feed these polymers into a 3-D Printer," Dr Connal said.

The project is challenging from both the synthesis and production side of creating the material, to the printing side, ensuring that the material has the right shape and complex properties to carry out its function, as well as being 3-D printable.

A filament must first be produced, which can be fed into the printer, melted and 3-D printed. There are a lot of challenges in the chemistry and the properties of making the filament, determining the thermal properties aside with optimising the production conditions to make it printable.

"Very few scientists have dealt with this problem, because it is quite challenging. Our paper is one of the few in the field," Ms Nadgorny said.

The smart polymers could be used in a few ways. A flow regulation device has been made, which consists of a polymer valve that opens and closes to control the flow rate of water, dependent upon the pH of the water flowing through it.

The second is a catalytic device that can remove an environmental pollutant from water. In the experiment conducted, the 3-D printed polymer catalyst is placed in a yellow (contaminated) solution, which turns clear over time, when the toxic substance has been neutralised.

"This is early research for us in the area of functional polymers and 3-D printing and we believe there is scope to further develop the work and to partner with industry in creating novel solutions with these new smart materials," Dr Connal said.

More information: Milena Nadgorny et al. Three-Dimensional Printing of pH-Responsive and Functional Polymers on an Affordable

Desktop Printer, *ACS Applied Materials & Interfaces* (2016). DOI: 10.1021/acsami.6b07388

Provided by University of Melbourne