Smart surfaces with switchable superoleophilicity and superoleophobicity in aqueous media: toward controllable oil/water separation

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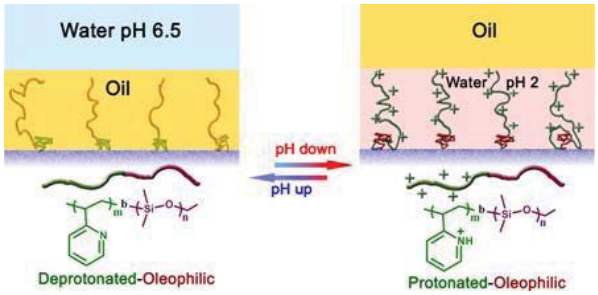
Abstract

Advanced materials with surfaces that have controllable oil wettability when submerged in aqueous media have great potential for various underwater applications. Here, we have developed smart surfaces on commonly used materials, including non-woven textiles and polyurethane sponges, that are able to switch between superoleophilicity and superoleophobicity in aqueous media. The smart surfaces are obtained by grafting a block copolymer comprising blocks of pH-responsive poly(2-vinylpyridine) and oleophilic/hydrophobic polydimethylsiloxane (i.e., P2VP-*b*-PDMS) on these materials. The P2VP block can alter its wettability and its conformation via protonation and deprotonation in response to the pH of aqueous media, which provides controllable and switchable access of oil by the PDMS block, resulting in the switchable surface oil wettability in aqueous media. On the other hand, the high flexibility of the PDMS block facilitates the reversible switching of the surface oil wettability. As a proof of concept, we also demonstrate that materials functionalized with our smart surfaces can be used for highly controllable oil/water separation processes.

Figure: Graphic abstract



Schematics showing the switchable oil wettability of the P2VP-b-PDMSgrafted surface in aqueous media with different pH.

[1] Zhang, LB., Zhang, Z.H., Wang, P. 2012, *NPG Asia Materials* (DOI: *doi:10.1038/am.2012.14*).

Formation and evolution of Precambrian crust in South China: insights from the Dongling complex

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To understand the early history of Precambrian crust in South China, a combined study of isotope geochronology and geochemistry was carried out for a Precambrian complex at Dongling, which was traditonally viewed as one of the most anicent basements in South China. The Dongling Complex is exposed at Anqing in the interior of South China and mainly composed of schist and gneiss. It is intruded by a Mesozoic granite pluton and covered by Phanerozoic strata. We analyzed whole-rock major and trace elements, zircon U-Pb and Lu-Hf isotopes, and mineral oxygen isotopes in schist and gneiss from the Dongling complex. The results provide not only temporal constraints on the deposition and metamorphism of metasedimentary protolith, but also insights into the formation and evolusuion of Precambrian crust in South China.

The whole-rock REE and trace elements in the Dongling complex show similar patterns in the spidergram to PAAS and upper continental crust. Mineral O isotope analyses obtained that most zircon $\delta^{18}O$ values are higher than 6‰ and most quartze $\delta^{18}O$ values are higher than 10‰, suggesting that their sources experienced low-temperature supracrustal recycling. Zircon U-Pb dating gave three groups of Precambrian ages. The first group of ages are older than 2.4 Ga, as high as 2.8 Ga. Some of them were obtained from inherited zircon cores and others are from the detrital zircon of Archean age. The second group is about 2.0 Ga, mainly obtained from zircon without oscillatory zone. The third group is about 800 Ma and can be categorized into two subgroups at 730-780 Ma and 800-830 Ma. This group of zircon have typical oscillatory zones of magmatic origin. Zircon grains with different U-Pb ages have similar REE partition patterns but variable total REE concentrations, indicating diversity of their sources. Zircon Lu-Hf isotope compositions vary significantly for three groups of zircons. The first group has variably negative $\varepsilon_{Hf}(t)$ values. The ~2.0 Ga zircon grains have variable $\varepsilon_{Hf}(t)$ values from -19.8 to -5.6 and two-stage Hf model ages (T_{DM2}) from 2.99 to 3.81 Ga, suggesting reworking of Archaen rocks in the middle Palaeproterozoic. The ~800 Ma zircon grains have variable $\varepsilon_{Hf}(t)$ values from -24.8 to 4.9 and T_{DM2} from 1.39 to 3.18 Ga, suggesting reworking of both ancient and juvenile crustal rocks in the middle Neoproterozoic. There is a lack of positive $\varepsilon_{Hf}(t)$ values close to the depleted mantle value, suggesting that the growth of juvenile crust is not recorded in these zircon grains.

In conclusion, premetamorphic protolith of the Dongling complex was probably deposited at middle Neoproterozoic. It contains crustal relicts of Late Archean, Paleoproterozoic and Neoproterozoic, suggests crustal reworking at these times in South China.