Supporting Information

Figure S1

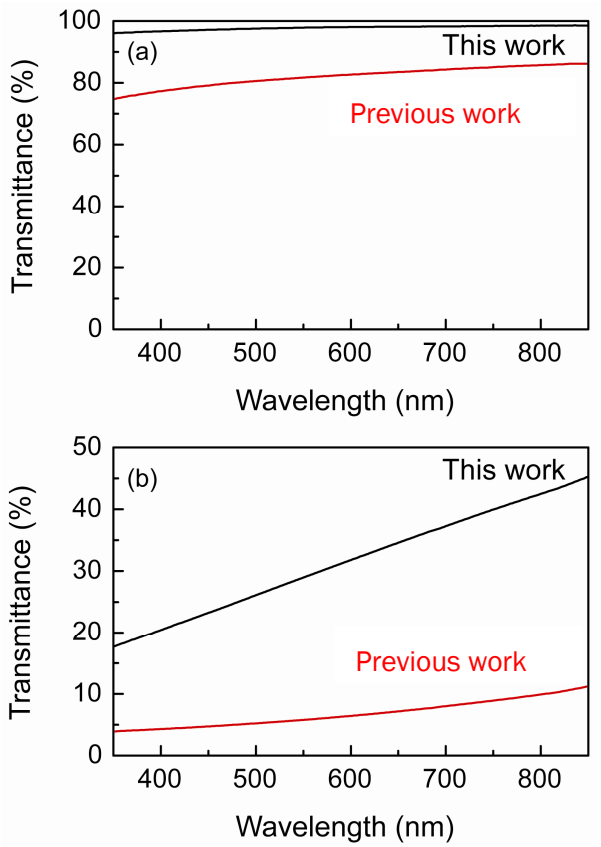

Figure S1 UV-VIS-NIR spectra of (a) silicone rubber itself and (b) silicone rubber compound with 10 wt% mesoporous silica. The thickness of each sample was fixed to 50 μm.

Calculation of adsorbed amount of toluene in each composite

Silicone rubber without silica fillers:

Initial weight before swelling and weight after adsorption equilibrium are 0.2328 g and 0.3906 g, respectively. Thus, the adsorbed amount of toluene per a unit weight of silicone rubber is 0.6778 g/g (= (0.3906 g – 0.2328 g) / 0.2328 g).

NS_25 wt%:

The initial weight of NS_25% composite is 0.1925 g. The weights of silicone rubber and silica particle are 0.1444 g and 0.0481 g, respectively. After adsorption equilibrium, the composite weight is increased to 0.2708 g. Assuming that the toluene adsorption on silica particles do not occur, the silicone weight after the swelling is 0.2227 g (= 0.2708 g – 0.0481 g). Thus, the adsorbed amount of toluene per a unit weight of silicone rubber is calculated to be 0.5422 g/g (= (0.2227 g – 0.1444 g) / 0.1444 g).

TMS-TMPS_25 wt%

The initial weight of TMS-TMPS_25% before the swelling is 0.2507 g. The weight of mesoporous silica particles is 0.0627 g. The relative weight ratio of silicon inside the mesopores in **TMPS_25 wt%** is 29.0 wt%. So, the weight of silicone inside the mesopores is

$$0.2507 \times \frac{100-25}{100} \times \frac{29.0}{100} = 0.0545(g).$$

Similarly, the relative weight ratio of silicone outside the mesopores in **TMPS_25 wt%** is 71.0 wt%. So, the weight of silicone inside the mesopores is

$$0.2507 \times \frac{100-25}{100} \times \frac{71.0}{100} = 0.1335(g).$$

The weight after toluene adsorption equilibrium was 0.3582 g. We assume that the mesoporous silica filler do not adsorb toluene.

In addition, taking into account of total pore volume of **TMPS-4** (0.8886 $cm^3 \cdot g^{-1}$) and dead pore

ratio of **TMS_TMPS 25 wt%** (91.4 vol%), the remained mesopore volume without being filled by silicone is

$$0.0627\times 0.8886\times \frac{100-91.4}{100}=0.0048\left(cm^3\right).$$

There are the following three possibilities on toluene adsorption.

Case I Only silicone outside the mesopores adsorbs toluene. The weight of silicone outside the mesopores after the adsorption equilibrium is

$$0.3582-0.0627-0.0545=0.2410(g).$$

The adsorption amount of toluene per 1 g of silicone (outside the mesopores) is

$$\frac{0.2410-0.1335}{0.1335}=0.8052(g/g).$$

Case II Silicone both inside and outside the mesopores adsorbs toluene, but the toluene do not enter the remained mesopores. The weight of silicone after toluene adsorption equilibrium is

$$0.3582-0.0627=0.2955(g).$$

The adsorption amount of toluene per 1 g of silicone is

$$\frac{0.2955-(0.0545+0.1335)}{(0.0545+0.1335)}=0.5718(g/g).$$

Case III Silicone both inside and outside the mesopores adsorbs toluene and toluene enters the remained mesopores. The amount of toluene (density: 0.866 g·cm^{-3}) introduced into the mesopores after the adsorption equilibrium is

$$0.0048\left(cm^3\right)\times 0.866\left(g/cm^3\right)=0.0042(g).$$

The weight of silicone after the adsorption equilibrium is

$$0.3582-0.0627-0.0042=0.2913(g).$$

Therefore, the adsorption amount of toluene per 1 g of silicone is

$$\frac{0.2913-(0.0545+0.1335)}{(0.0545+0.1335)}=0.5495(g/g).$$