

Article

Photocurable Carbon Nanotube/Polymer Nanocomposite for the 3D Printing of Flexible Capacitive Pressure Sensors

Jia-Wun Li ^{1,†}, Ho-Fu Chen ^{1,†}, Peng-Han Huang ^{1,†}, Chung-Feng Jeffrey Kuo ¹, Chih-Chia Cheng ² and Chih-Wei Chiu ^{1,*}

¹ Department of Materials Science and Engineering, National Taiwan University of Science and Technology, Taipei 10607, Taiwan

² Graduate Institute of Applied Science and Technology, National Taiwan University of Science and Technology, Taipei 10607, Taiwan

* Correspondence: cwchiu@mail.ntust.edu.tw; Tel.: +886-2-2737-6521

† These authors contributed equally to this work.

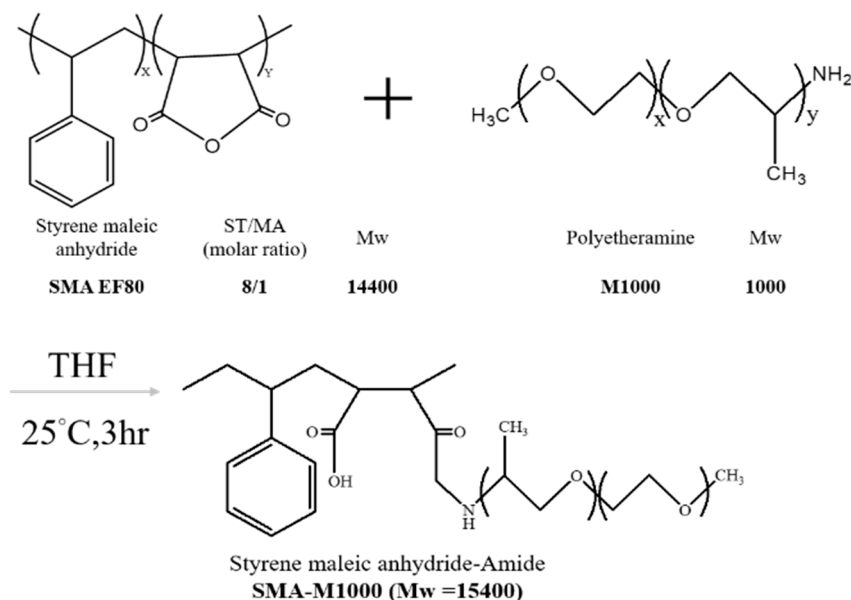


Figure S1. Synthesis of SMA-M1000 polymeric dispersant.

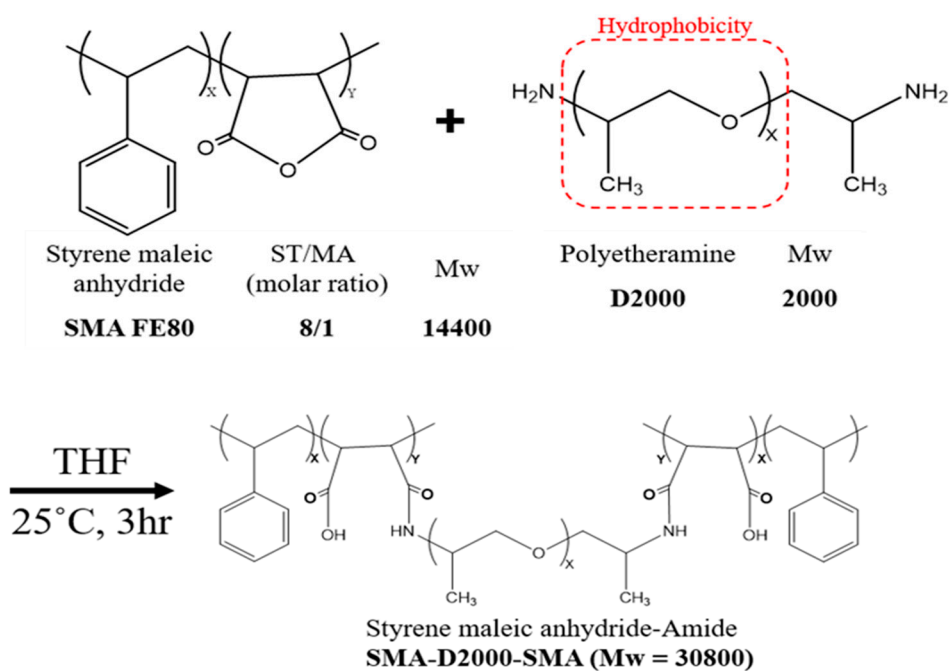


Figure S2. Synthesis of SMA-D2000 polymeric dispersant.

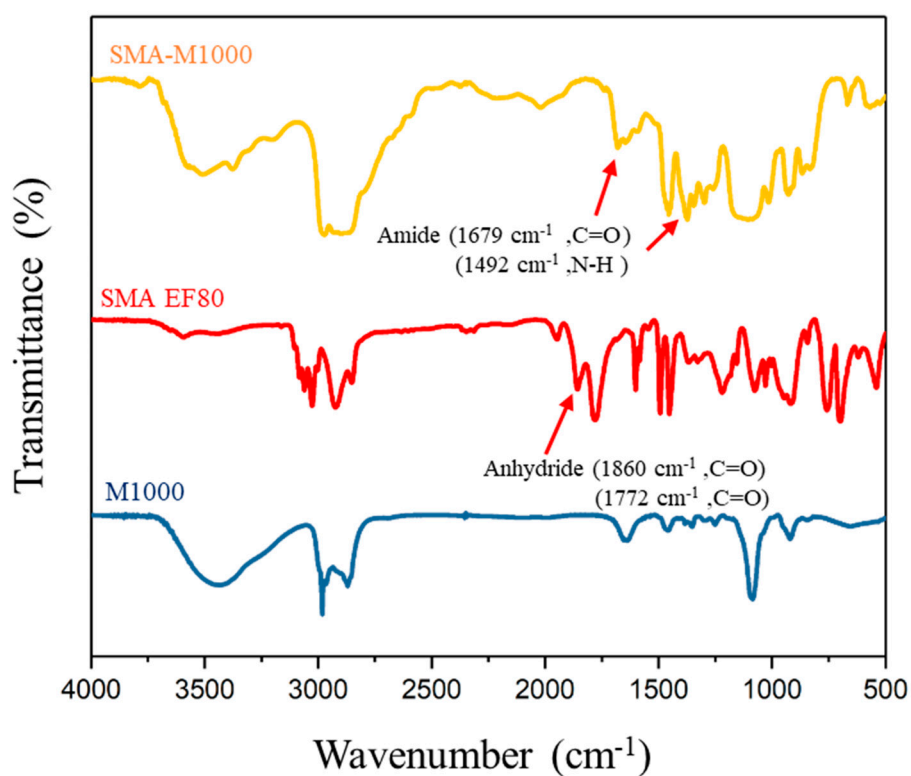


Figure S3. FT-IR analysis of M1000, SMA EF80, and SMA-M1000.

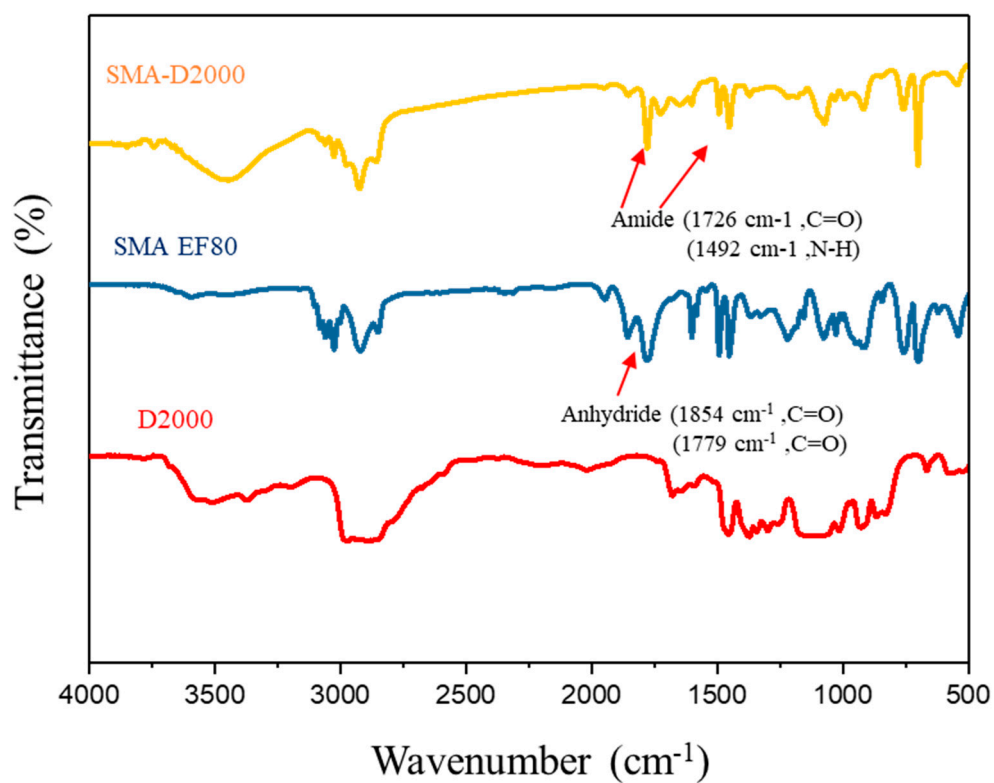


Figure S4. FT-IR spectra of D2000, SMA EF80, and SMA-D2000.

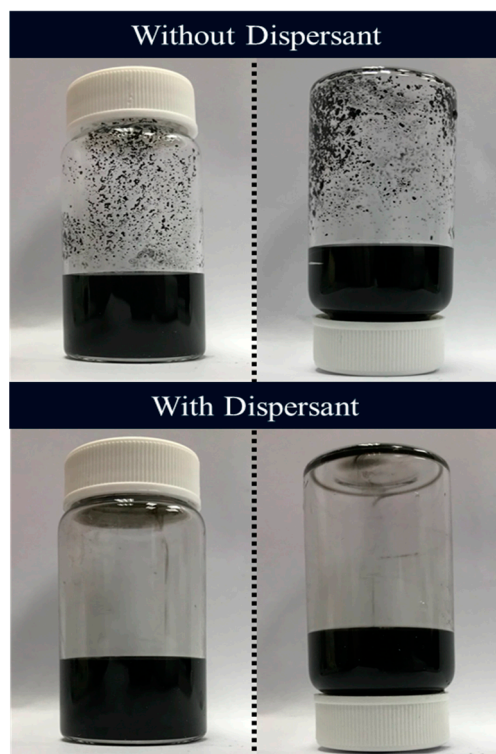


Figure S5. Photographs of CNT dispersion before and after adding polymeric dispersants.

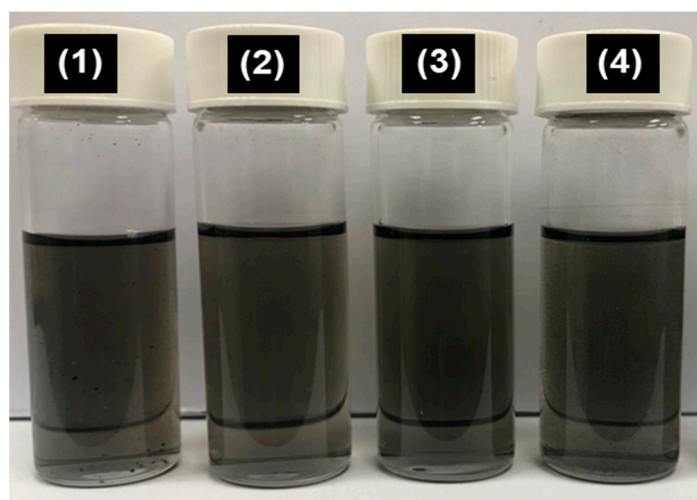


Figure S6. Photographs of CNT/polymer dispersions immediately after preparation: (1) without dispersant, (2) EF80, (3) M-1000, and (4) SMA-M1000.

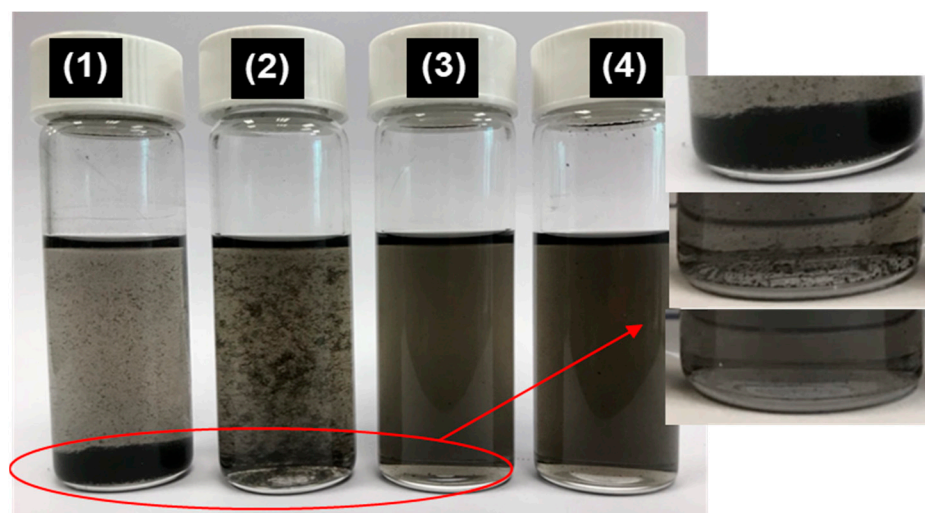


Figure S7. Photographs of CNTs/polymer dispersions five days after preparation: (1) without dispersant, (2) EF80, (3) M-1000, and (4) SMA-M1000.

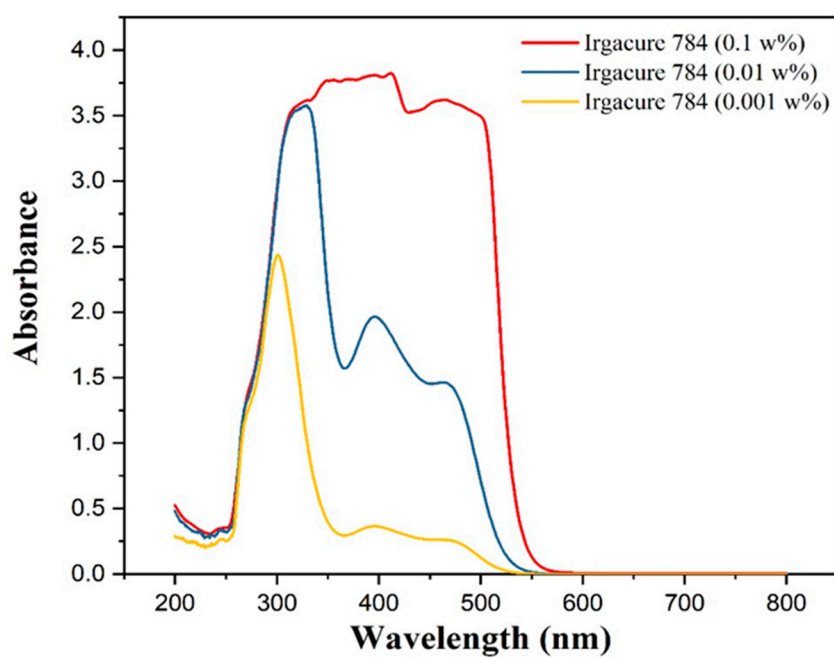


Figure S8. UV-vis spectrum of the photoinitiator.

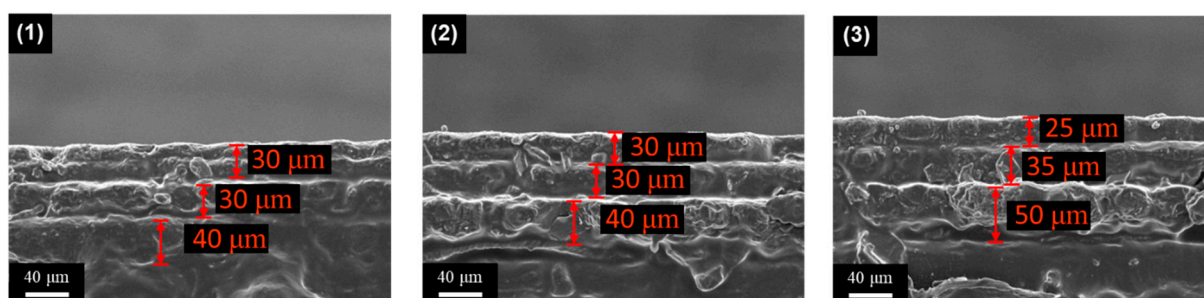


Figure S9. FE-SEM observation of the cross-section of 3D-printed objects with different layer heights: (1) 30 µm, (2) 40 µm, and (3) 50 µm.

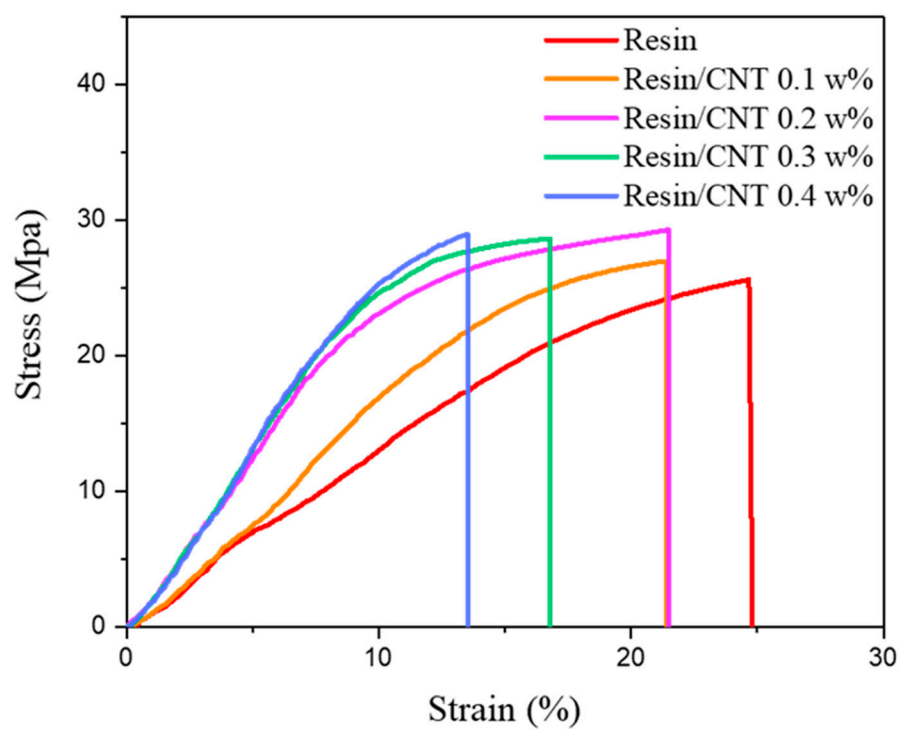


Figure S10. Stress–strain curves of CNT/resin nanocomposites without dispersant.

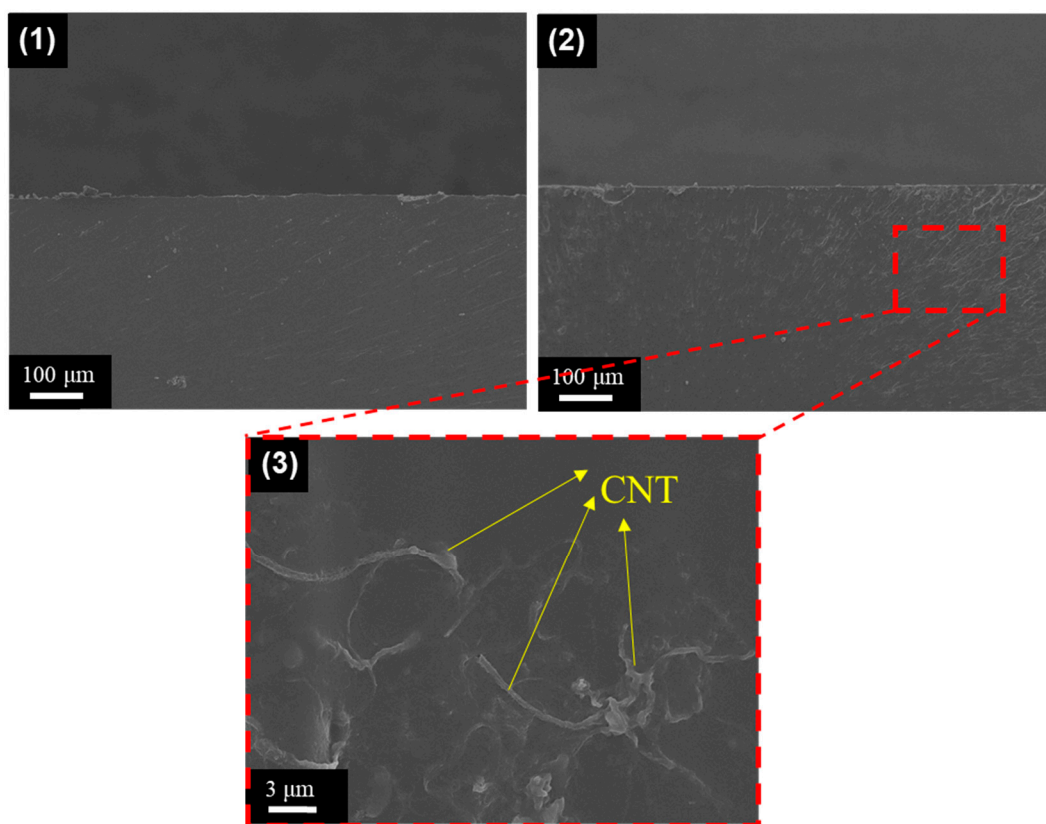


Figure S11. FE-SEM micrographs of the fracture surface of CNT/resin nanocomposites after tensile failure. (1) Pure resin (without CNT); (2) nanocomposite with 0.3 wt% CNT; (3) magnified view of an area in (2).

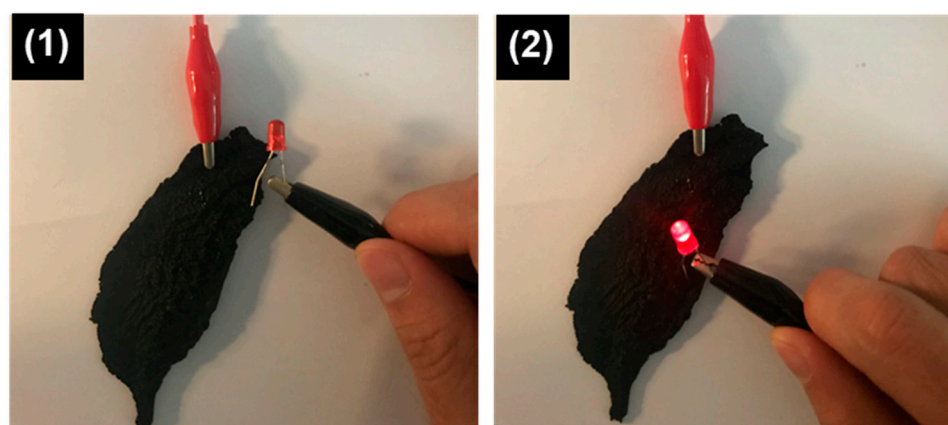


Figure S12. Demonstration of the conductivity of an object fabricated via DLP 3D-printing with the developed photocurable resin/CNT nanocomposite.

```
#include <CapacitiveSensor.h>

CapacitiveSensor cs1 = CapacitiveSensor(6,7);
CapacitiveSensor cs2 = CapacitiveSensor(6,5);
int ledPin = 2;
int ledPin2 = 3;
void setup() {
  Serial.begin(9600); // put your setup code here, to run once:
  pinMode(ledPin, OUTPUT);
  pinMode(ledPin2, OUTPUT);
}

void loop() {
  // put your main code here, to run repeatedly:
  long cs1v = cs1.capacitiveSensor(80);
  long cs2v = cs2.capacitiveSensor(80);

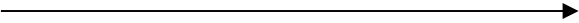
  if(cs1v>300)
    digitalWrite(ledPin, HIGH);
  else
    digitalWrite(ledPin, LOW);

  if(cs2v>300)
    digitalWrite(ledPin2, HIGH);
  else
    digitalWrite(ledPin2, LOW);

  Serial.print(cs1v);
  Serial.print(" ");
  Serial.println(cs2v);
  delay(100);
}
```

Figure S13. Arduino code for the capacitive pressure sensor.

Table S1. Solubility of the polymeric dispersants in different solvents.

Polar Solvents 						Non-Polar Solvents	
Solvent	H ₂ O	DMF	NMP	EtOH	MEK	THF	Toluene
SMA EF80	-	+	+	-	+	+	-
M000	+	+	+	+	+	+	+
D2000	-	+	+	+	+	+	+
SMA-M1000	+/-	+	+	+	+	+	+
SMA-D2000	-	+	+	+	+	+	+

+: soluble; +/-: soluble but forming sediments after 2 h settlement; -: insoluble.