Electronic Supplementary Material (ESI) for ChemComm.

Supporting information

Magneto-Optically Active Magnetoplasmonic Graphene

Jaewook Lee[1,2], Jaebeom Lee[1**]

[1] Department of Nano Fusion, and Cogno-Mechanical Engineering, Pusan National University, Busan 609-735, Republic of Korea

[2] Research Institute of Green Science and Technology, Shizuoka University, Shizuoka, 422-8529, Japan

*Corresponding Author: jaebeom@pusan.ac.kr

Experimental method

Hydrogen tetrachloroaurate (III) trihydrate ($HAuCl_4{\cdot}3H_2O$, 99.9%), GA (3,4,5-trihydroxy benzoic acid), $FeCl_3{\cdot}6H_2O$, $FeCl_2{\cdot}4H_2O$, and a 25% ammonia solution were obtained from Sigma–Aldrich (Yongin, South Korea). D.I. water (18.2 mΩ/cm) was used throughout the experimental procedure. All the chemicals were of analytical grade and were used as received. Graphene flakes (model #: AO-3) were purchased from Graphene Supermarket (Reading, MA, USA). The average thickness of each graphene flake was 12 nm, which corresponded to 30–50 graphene sheets. Furthermore, these flakes were based on a graphite structure; therefore, they contain less than 1% oxygen. The absorbance of the MPGRP was measured using UV-vis spectroscopy (Agilent, 8453, USA). The SERS effect was monitored using Raman spectroscopy (Witec, Alpha 300 D, USA). The morphologies and sizes of the nanostructures were characterized using highresolution TEM (HR-TEM, JEOL, JEM-3011, Japan). The magnetization of the MPGRP was analysed using a SQUID (Quantum Design, MPMS XL, USA). The light polarization of the MPGRP was measured using MCD spectroscopy (JASCO, J-815, Japan)

Synthesis of oxidizable GA-MNPs and MPGRP

The GA-MNPs were synthesized using a co-precipitation method. $FeCl_3$ (1 mmol, 0.1622 g) and $FeCl_2{\cdot}4H_2O$ (0.5 mmol, 0.0994 g) were dissolved in 20 mL of D.I. water. Subsequently, 0.6 mL of ammonia solution was added to the iron–salt mixture and stirred for 10 min to form iron oxide before adding 1.5 mmol of GA (0.255 g) powder and stirring at 90 °C for 30 min. Upon binding the iron with the GA, the solution changed from black to deep purple. Following the reaction, GA-MNPs were precipitated with acetone and then purified by centrifugation and magnetic separation. Finally, the GA-MNPs were dried in a vacuum oven. The MPGRP was prepared via a facile two-step process. Initially, 10 mmol of $HAuCl_4{\cdot}3H_2O$ (4 mg) and 1.5 mg of graphene flakes were dispersed in 20 mL of D.I. water by sonication for 30 min. During this process, Au^{3+} ions were attached to the surfaces of the graphene sheets. Separately, GA-MNP (1 mg/mL concentration) was also dispersed in D.I. water by sonication for 10 min to produce a reducing agent. Subsequently, to reduce the Au ions and decorate the graphene sheet, 1 mL of the GA-MNP solution was added to the Au^{3+}/graphene mixture, and the resulting mixture was stirred for 3 h under ambient conditions. Finally, the MPGRP was purified by centrifugation at 8500 rpm, magnetically separated, and dried in a vacuum oven at room temperature.

Supporting Figures

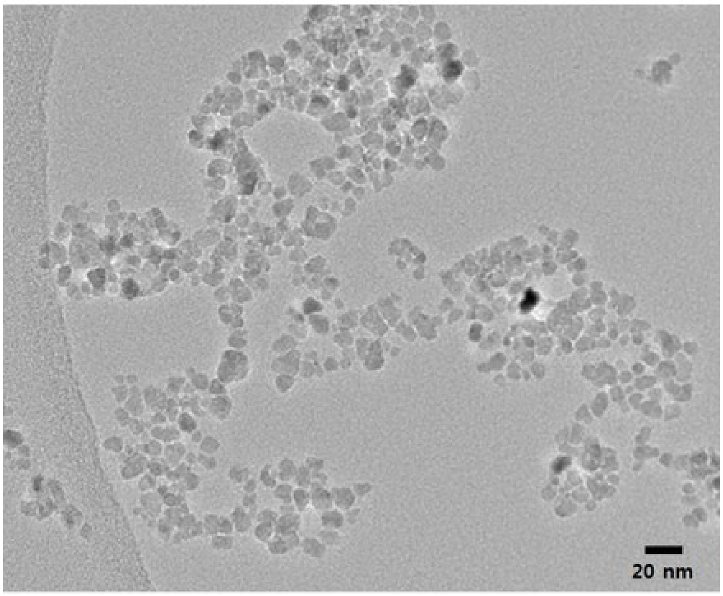

Fig. S1. TEM image of GA-MNP.

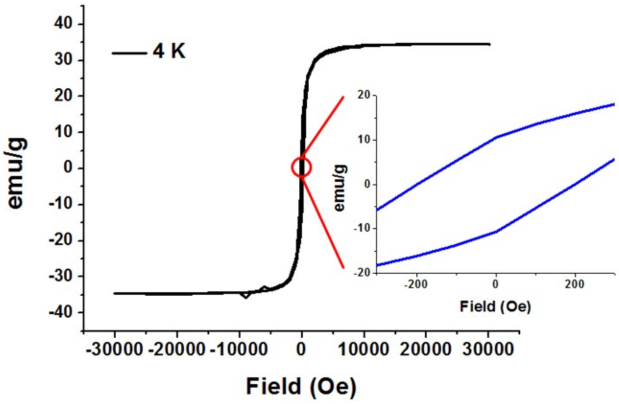

Fig. S2. Magnetic property of MPGRP. SQUID hysteresis loop of MPGRP at 4.2 K (inset: expanded hysteresis loop).

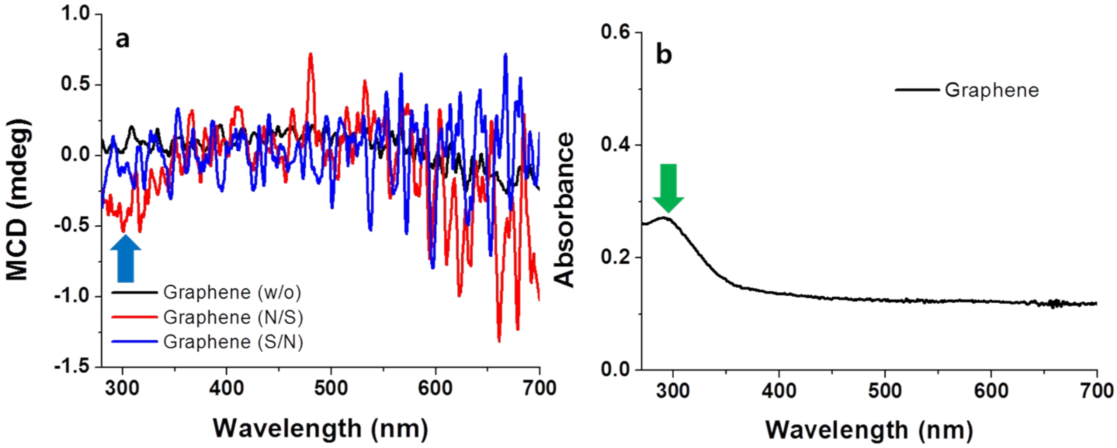

Fig. S3. a. MCD spectra of graphene under 1.4 T and b. UV/Vis spectrum of graphene