Supporting Information

Dry synthesis of pure and ultra-thin nanoporous metallic films

Hyunah Kwon, Hannah-Noa Barad, Alex Ricardo Silva Olaya, Mariana Alarcon-Correa, Kersten Hahn, Gunther Richter, Gunther Wittstock, Peer Fischer *

H. Kwon, M. Alarcon-Correa, and P. Fischer
Institute for Molecular Systems Engineering and Advanced Materials, Heidelberg University, INF 225, 69120 Heidelberg, Germany; and Max Planck Institute for Medical Research, Jahnstrasse 29, 69120 Heidelberg, Germany
E-mail: peer.fischer@mr.mpg.de

H.N. Barad
Department of Chemistry, Institute for Nanotechnology and Advanced Materials, Bar-Ilan University, Ramat Gan, 5290002 Israel

A. R. Silva Olaya, G. Wittstock
School of Mathematics and Science, Department of Chemistry, Carl von Ossietzky University of Oldenburg, 26111 Oldenburg, Germany

G. Richter
Max Planck Institute for Intelligent Systems, Heisenbergstrasse 3, 70569 Stuttgart, Germany

K. Hahn
Max Planck Institute for Solid State Research, Heisenbergstrasse 1, 70569 Stuttgart, Germany

Table S1. Melting points and surface energies of metals.

	Ag	Au	Ni	Fe	Pd	Pt
Melting point (°C)	**961**	**1063**	**1453**	**1538**	**1555**	**1770**
Surface energy (J/m^2)	**1.2**	**1.3-1.7**	**2.0-2.4**	**2.4**	**1.9-2.2**	**2.3-2.8**

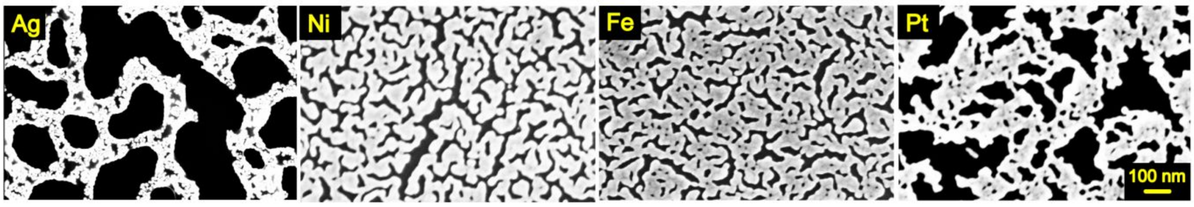

Figure S1. SEM images of different NPMFs that are fabricated with the same process parameters. Metals were evaporated on a PMMA thin film with an oblique angle of 80 °, with a rate of 0.05 nm/s, 10 nm target thickness, and rotation speed 0.72 °/s. They were plasma-treated in 0.4 mbar W10 ambient (Ar 90 %, H_2 10%) with 300 W for 15 min.

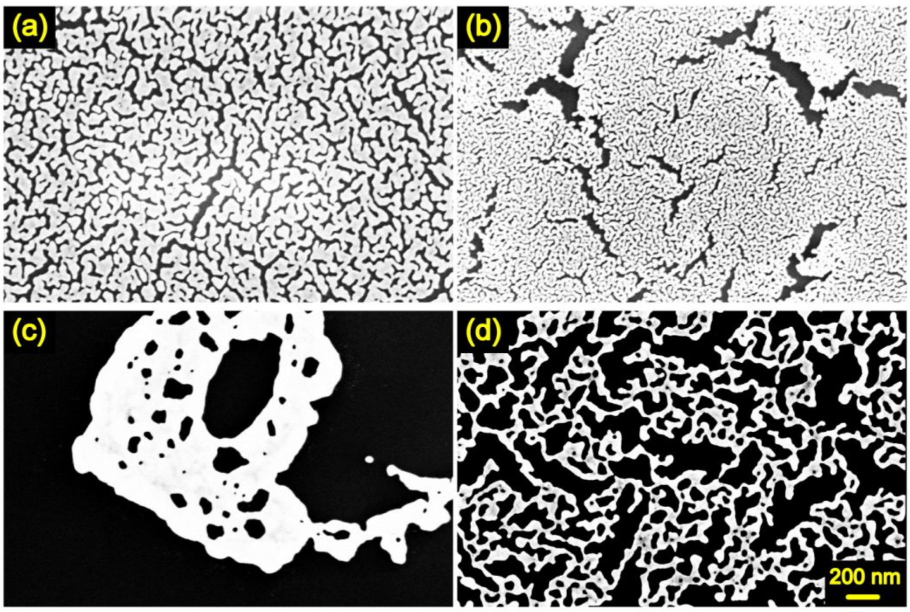

Figure S2. Morphology control of NPMFs as a function of the plasma conditions. (a-b) NPNFs for different plasma conditions: (a) 0.4 mbar W10 (Ar 90 %, H_2 10 %) ambient with 300 W for 15 min, and (b) 0.4 mbar Ar ambient with 200 W for 15 min. (c-d) NPGF for different plasma conditions: (c) 0.4 mbar W10 (Ar 90 %, H_2 10 %) ambient with 300 W for 15 min, and (d) 0.4 mbar air ambient with 200 W for 25 min.

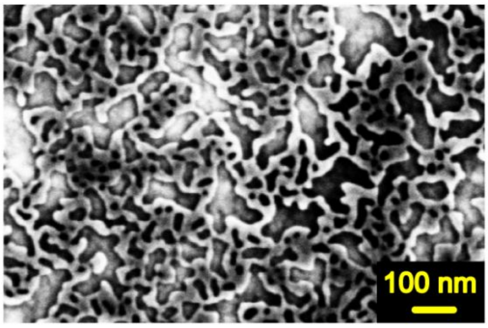

Figure S3. SEM image of NPGF on double-side polished sapphire. The appearance is similar to Figure 1b, which indicates that the morphology of the film is largely determined by the plasma conditions and the interaction of the metal with the PMMA layer and to a smaller extent due to interactions with the inorganic substrate.

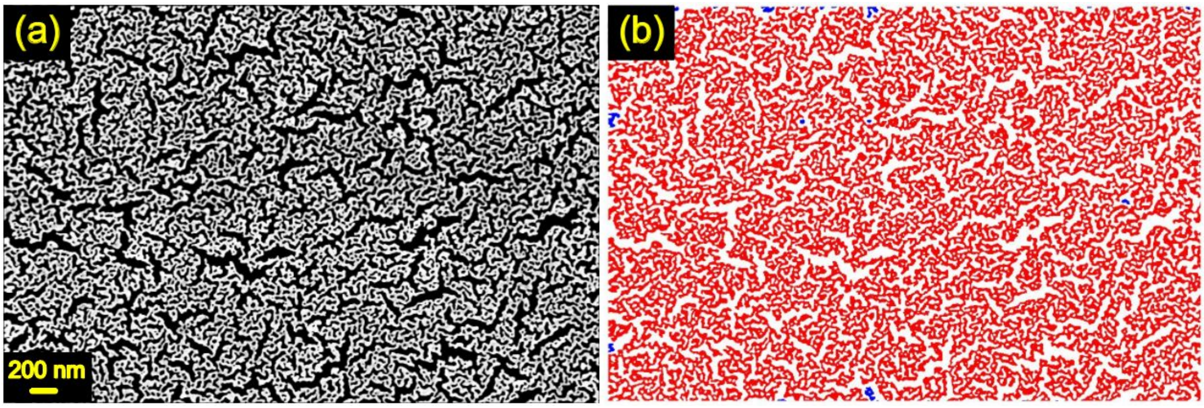

Figure S4. (a) SEM image of a NPGF. (b) After analyzing the image pixel connectivity (8-connected pixels) of pixels that are connected along the horizontal, vertical, or diagonal direction, connected structures are colored red (unconnected regions are blue and these are almost not present). It is thus seen that almost all ligaments are fully connected. A SEM image of the NPGF film was converted to a binary image with a resolution of 1024 × 680, (black and white) by adapting a thresholding method (the threshold value is 50).[2]

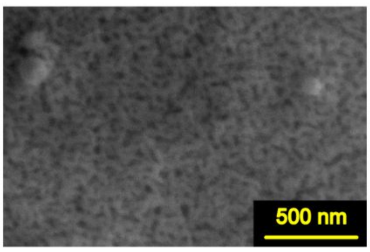

Figure S5. SEM image of top view of folded NPGF that was fabricated by lifting off in a diluted KOH solution.

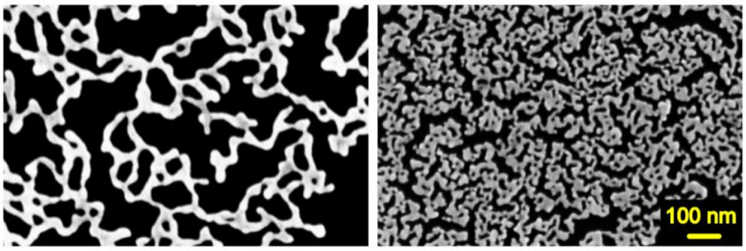

Figure S6. NPGF (left) and nanoporous Au:Ag (80:20) film (right). The Ag win the Au:Ag film was co-deposited but at a lower rate to obtain the final ratio of 80:20 (determined by the deposited thickness ratio). The same plasma conditions were used for both films. It is seen that the ligament size is very different, indicating that the precise metal composition provides a further control parameter to shape the ligament size and film morphology.