Supporting Information

Fabrication of Three-dimensional Porous Copper Phthalocyanine Films and Their Applications for NO_2 Gas Sensors

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Number of pages: 9

Number of figures:4

Number of tables: 1

Figure S1 Sensors test system illustration. (Page 2)

Figure S2 The output curves of the spin-coated CuPc/PVA ONFs films transistors. (Page 3).

Figure S3 Output curves and transfer curves of the spin-coated CuPc/PVA ONFs films transistors in different concentrations of NO_2 gas. (Page 5)

Figure S4 The atmosphere stability of the spin-coated CuPc/PVA ONFs films sensors was tested in the placed days during 15 days. (Page 6)

Table S1 Comparison of some recent reported semiconductors gas sensors of different types. (Page 7)

1. Sensor fabrication and measurement

The Au electrodes (~ 40 nm) were deposited onto the spin-coated CuPc/PVA ONFs films using a shadow mask for transistor fabrication. The films were equipped with 5 pairs (10 conductive channels) of finger electrodes for sensors, with a channel length and width of 100 μm and 3 mm respectively. The flow and concentration of the target gases were regulated by an automated mixed gas system utilizing original gases, while commercially purchased clean dry (synthetic) air was employed. The initial concentrations of NO_2 in the air were 1, 5, 10, 15, 20, and 25 ppm. The pure air served as the carrier gas, which was introduced into the device (enclosed in a chamber) at a velocity of 300 sccm during testing. The gas-off (pure air) pulses were maintained for a duration of 10 to 30 minutes, while the gas-on (target gases) pulses were also maintained for a duration of 10 to 30 minutes. The humidity controller regulates the moisture level of the gas entering the hermetically sealed testing chamber. The sensor system configuration is depicted in **Fig. S1**.

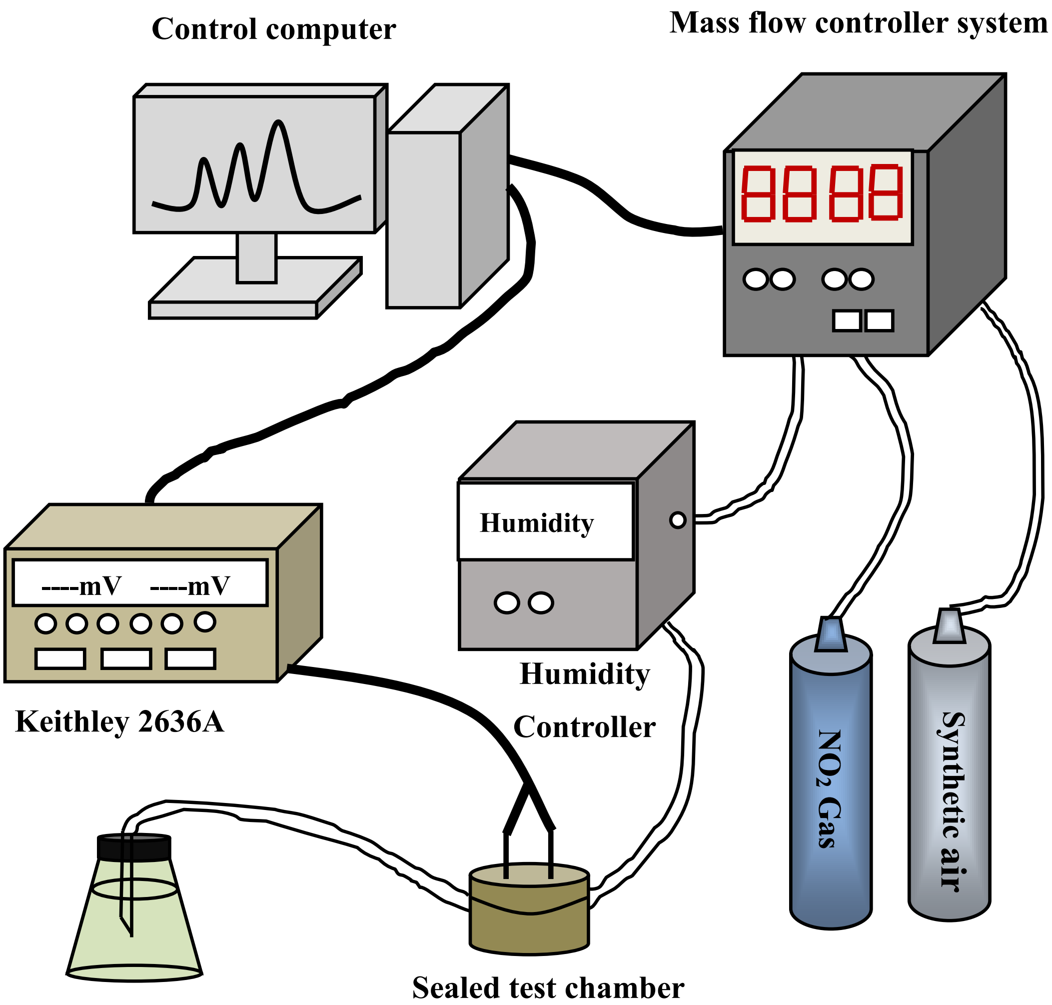

Fig. S1. Sensors test system illustration.

2. The effect of CuPc solution concentration on electrical properties of the spin-coated CuPc/PVA ONFs films

The electrical properties of the spin-coated CuPc/PVA ONFs films transistors were investigated to examine the impact of varying concentrations of CuPc solution on their performance. The output and transfer characteristic curves of the spin-coated CuPc/PVA ONFs films transistors with solution concentrations of 45 mg/mL, 75 mg/mL, and 105 mg/mL were illustrated in **Fig. S2**.

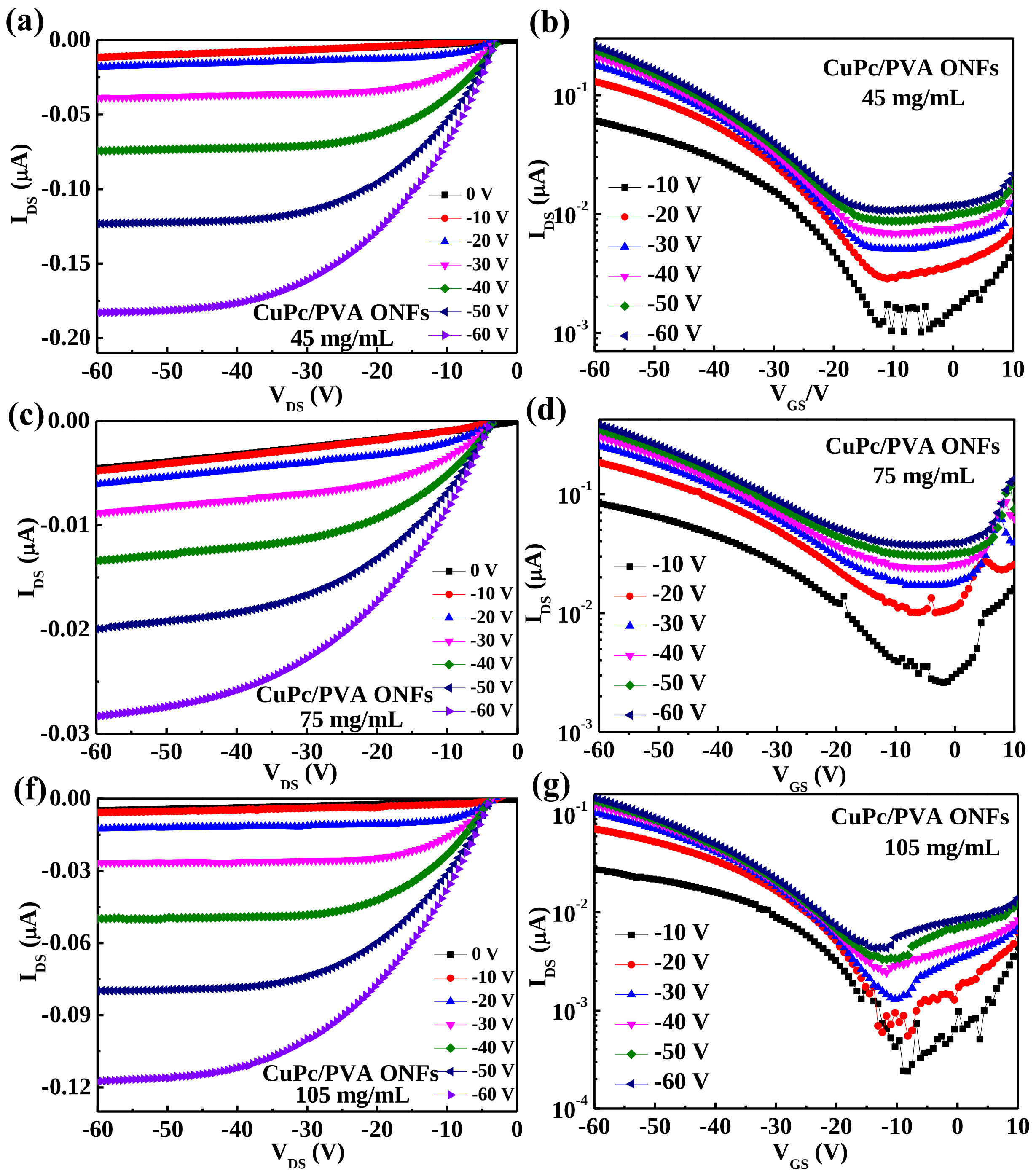

Fig. S2. The output curves of the spin-coated CuPc/PVA ONFs films transistors, (a) 45 mg/mL, (c) 75 mg/mL, (e) 105 mg/mL. Transfer curves of the spin-coated CuPc/PVA ONFs films transistors, (b) 45 mg/mL, (d) 75 mg/mL, (f) 105 mg/mL.

3. Effect of NO_2 gas concentration on electrical properties of the spin-coated CuPc/PVA ONFs films

The impact of varying concentrations of NO_2 gas on the electrical performance of OFETs composed of the spin-coated CuPc/PVA ONFs films was investigated. The output and transfer characteristic curves of the spin-coated CuPc/PVA ONFs films transistors with the CuPc solution concentration of 75 mg/mL were depicted in **Fig. S3** at NO_2 gas concentrations ranging from 0 ppm to 20 ppm, including levels of 0 ppm, 5 ppm, 15 ppm, and 20 ppm. The investigation of electrical properties is instrumental in advancing the analysis of the response mechanism exhibited by sensors based on the spin-coated CuPc/PVA ONFs films.

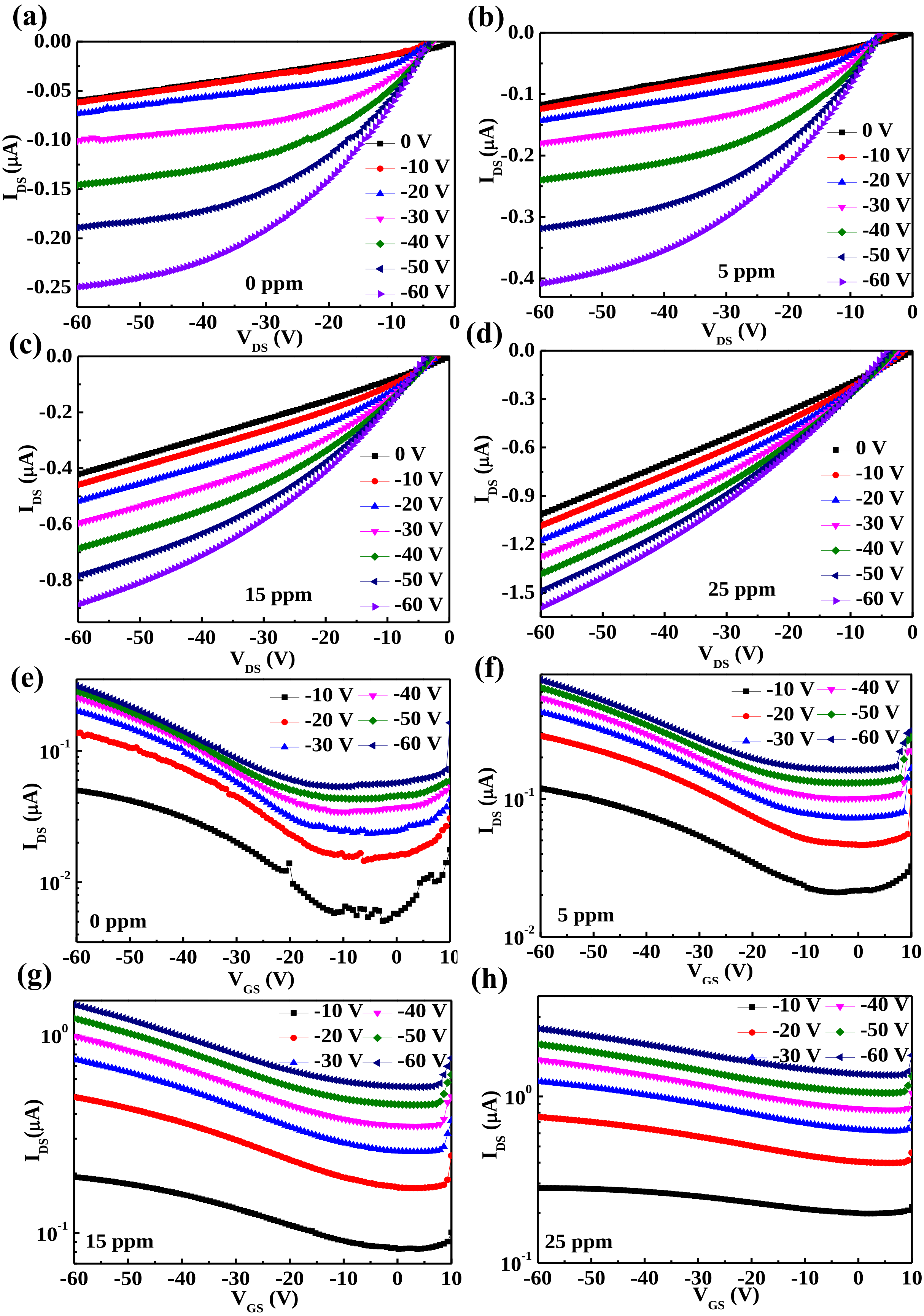

Fig. S3. Output curves and transfer curves of the spin-coated CuPc/PVA ONFs films transistors in different concentrations of NO_2 gas. (a, e) 0 ppm, (b, f) 5 ppm, (c, g) 15 ppm,

(d, h) 25 ppm.

4. Change of sensing effect of the spin-coated CuPc/PVA ONFs films sensors with time

The dynamic response curves of the spin-coated CuPc/PVA ONFs films sensors, which were exposed to 10 ppm NO_2 for 0, 5, 10, and 15 days, were presented in Fig. S4. The responsivities of the spin-coated CuPc/PVA ONFs films sensors to NO_2 at 15 ppm exhibited minimal temporal variation.

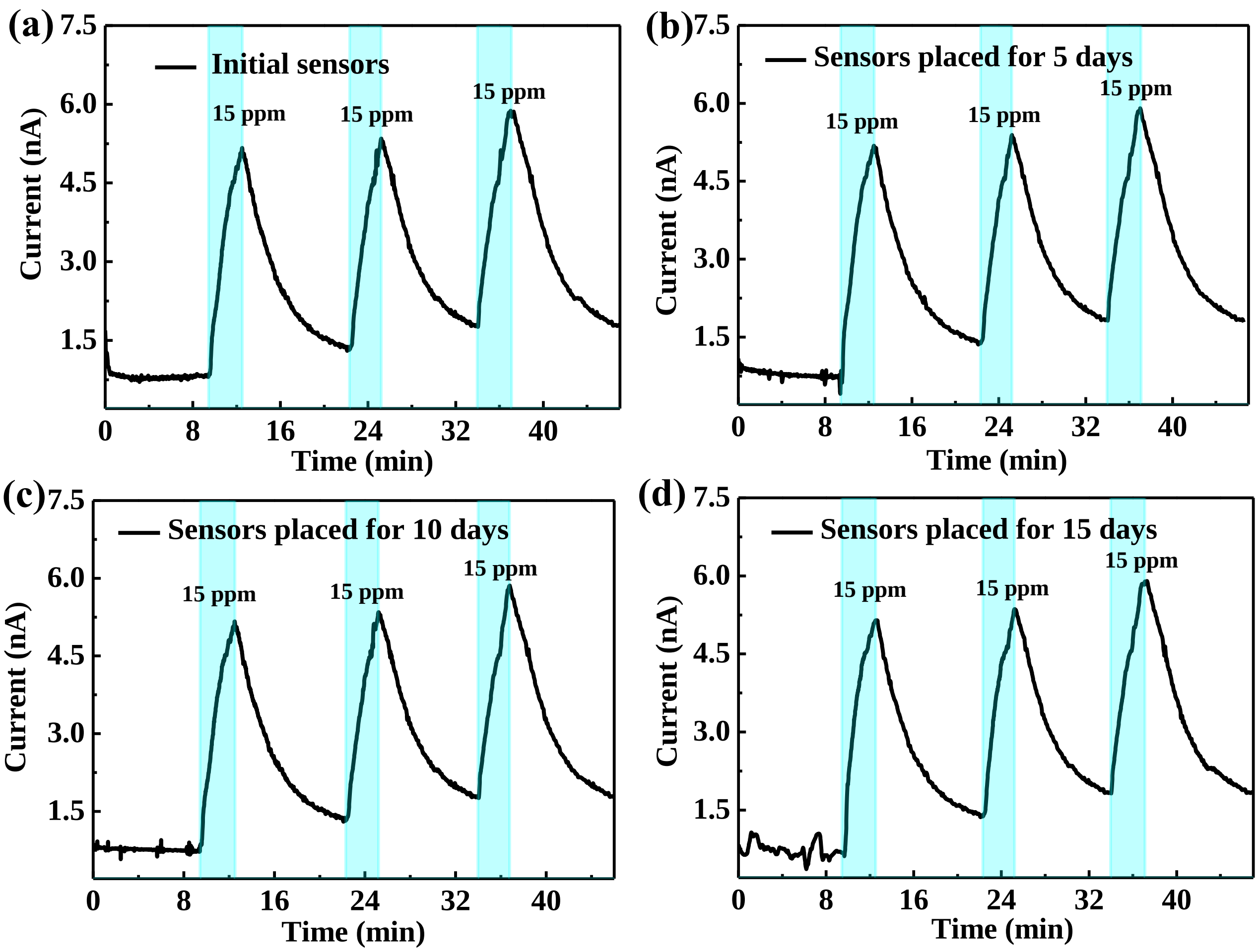

Fig. S4. The atmosphere stability of the spin-coated CuPc/PVA ONFs films sensors was tested in the placed days during 15 days. Continuous test stability curves of the spin-coated CuPc/PVA ONFs films sensors at 15 ppm and at room temperature (25 °C) and 35 % RH.

5. Summary of sensors in recent years

The advantages of spin-coated CuPc/PVA ONFs film sensors can be better understood by summarizing the relevant information from a series of sensors reported in recent years, as presented in **Table S1**.

Table S1. Comparison of some recent reported semiconductors gas sensors of different types.

Materials	Operating temperature (℃)	Detection limit	Target gas	Ref.
Spin-coated CuPc/ONFs film	RT	0.2 ppm	NO_2	Our work
spin-coated CuPc film	RT	0.3 ppm	NO_2	[1]
V-MOF(PTA) and V-MOF(PMA)	RT	1 ppm	NO_2	[2]
α-6T	RT	0.3 ppm	NO_2	[3]
N-doped SnO2-rGO nanohybrids	120	0.5 ppm	NO_2	[4]
CuPc/ ordered PVA nanofibers	RT	0.3 ppm	NO_2	[5]
CuPc/p-6P/ Al_2O_3/PMMA	RT	1 ppm	NO_2	[6]
Cu/ZnO/rGO nanocomposites	200	1 ppm	NO_2	[7]
rGO/ZnPc and rGO/CoPc nanohybrids	RT	30 ppm	NH_3	[8]
porous SnO_2	160	5 ppm	Cl_2	[9]
In_2O_3 nanosheets	200	3 ppm	Cl_2	[10]

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