Supporting Information

Hydrated negative air ions generated by air-water collision with TiO_2 photocatalytic materials

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Experimental sections

1. Materials and regents.

Titanium (IV) oxide (TiO_2), nanopowder, 21 nm primary particle size (TEM), ≥99.5% trace metals basis, was purchased from Sigma (St. Louis, MO, USA). Gum rosin was bought from Tsinghua University reagent supply platform. Fat soluble essential oil and water soluble essential oil were both purchased from online shopping platform used for verifying the effect of molecular weight on NAIs lifetime. The high-speed airflow used in this experiment was provided by a high-pressure cylinder and used deionized water to prepare HNAIs. In addition, the generator models used in this experiment were all hand-made in laboratory.

2. Preparation of Rosin-TiO_2 pedestal.

0.5 g rosin (one natural resin) was heated to 90 centidegree and kept in a softened state, in which the rosin can be shaped at will. And then, the softened rosin was pressed into a cylindrical model (d= 0.5 cm, h= 0.3 cm) to form a pedestal and maintained at 90 centidegree. 50 mg TiO_2 powder was evenly sprinkled on the top surface of the rosin pedestal. Under 110 centidegree, TiO_2 and rosin physically merged for one hour. After above mentioned procedure, cool the rosin-TiO_2 composite pedestal to room temperature and the unfixed TiO_2 powder was cleaned up.

3. Detection of essential oils by GC-MS

100 μL fat-soluble essential oil and water-soluble essential oil were added into 200 mL deionized water, respectively. These two essential oil solutions were stirred for 20 min at room temperature to form ultra-fine organic molecular microspheres or fully dissolved in deionized water. Take 2 mL above mentioned solutions for dehydration extraction treatment, respectively, and the main components of these two essential oils were detected by gas chromatography-mass spectrometry (GCMS-QP2010, SHIMADZU, Japan). Automated separation and qualitative analysis of the organic matter extract were carried out by GC-MS operating in electron ionization mode. The DB-5 capillary (Length: 30 m; Thickness: 0.25 μm; Diameter: 0.25 mm) was used for separation and the injection volume of sample was 2 μL. The carrier gas was at a constant flow of 1.5 mL/min. The oven temperature program as follows: keeping 50 ^oC for 3 min, increasing to 170 ^oC with the rate of 3 ^oC /min, and accelerating from 170 ^oC to 270 ^oC by 15 ^oC /min.

4. Negative air ions generation and detection.

We used two methods to produce NAIs, one was corona discharge through a 5 V NAIs generator (XHJ-D05FB, Beijing) connected to a DC high voltage power supply. Another way was via air-water two phase collision with rosin-TiO_2 composite materials. All of the NAIs were detected by COM-3200 (Japan). The detailed data of above mentioned instrument was showed in **Fig. S1**. Since all experiments were performed in an indoor environment, the experiments were mainly small-scale, with the detector fixed on a horizontal central axis 80 cm from the generator. NAIs generated under different conditions is continuously detected for at least 30 min to ensure the accuracy of the experiment result.

Supplementary Figures

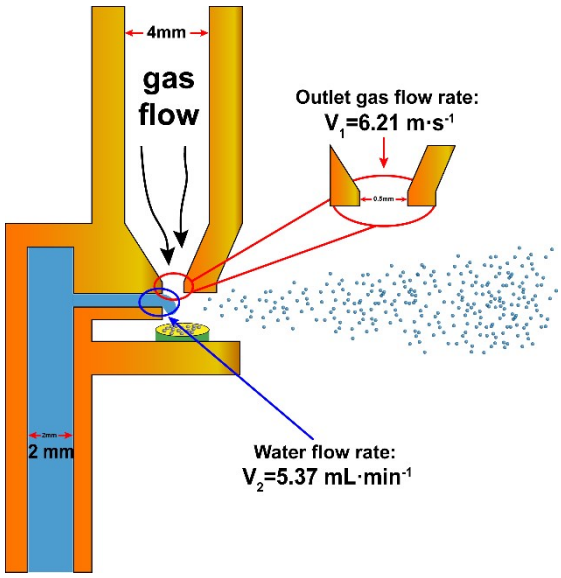

Fig. S1 Detailed data of the core device used for air-water collision.

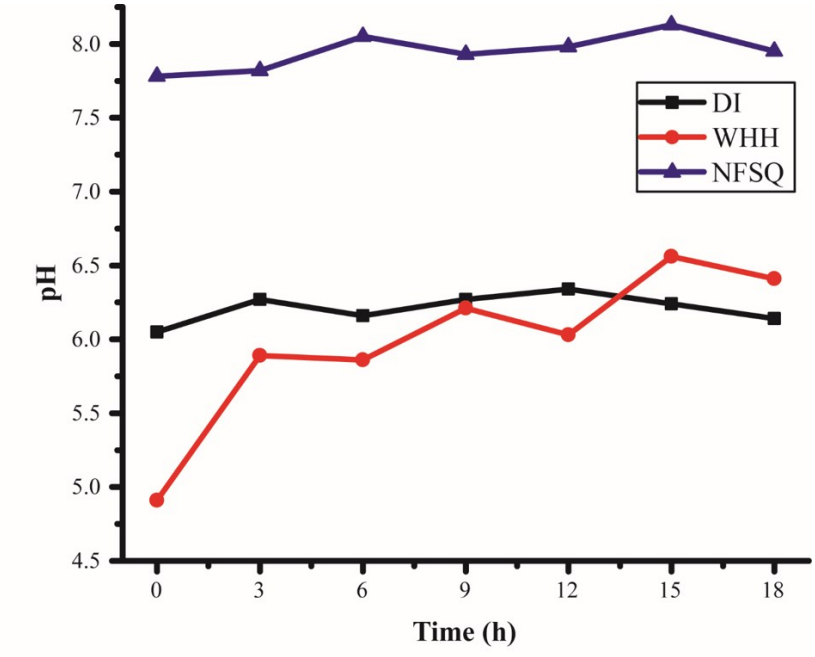

Fig. S2 Changing in pH of three different water solution used to prepare HNAIs in 18 h. Deionized water pH= 6.05 (maybe long time exposure to air leading to low pH); adjust WaHaHa with acetic acid, pH= 4.91; Nongfu Spring with NaOH, pH= 7.78.

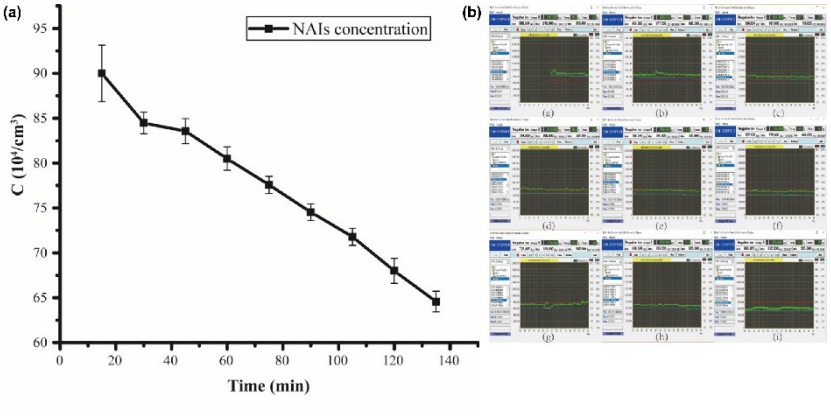

Fig. S3 The yield of HNAIs during the progress of pH increases from 5.86 to 6.21. (a) average intensity of HNAIs during 2h continuous detection; (b) real-time detection data recorded by COM-3200.