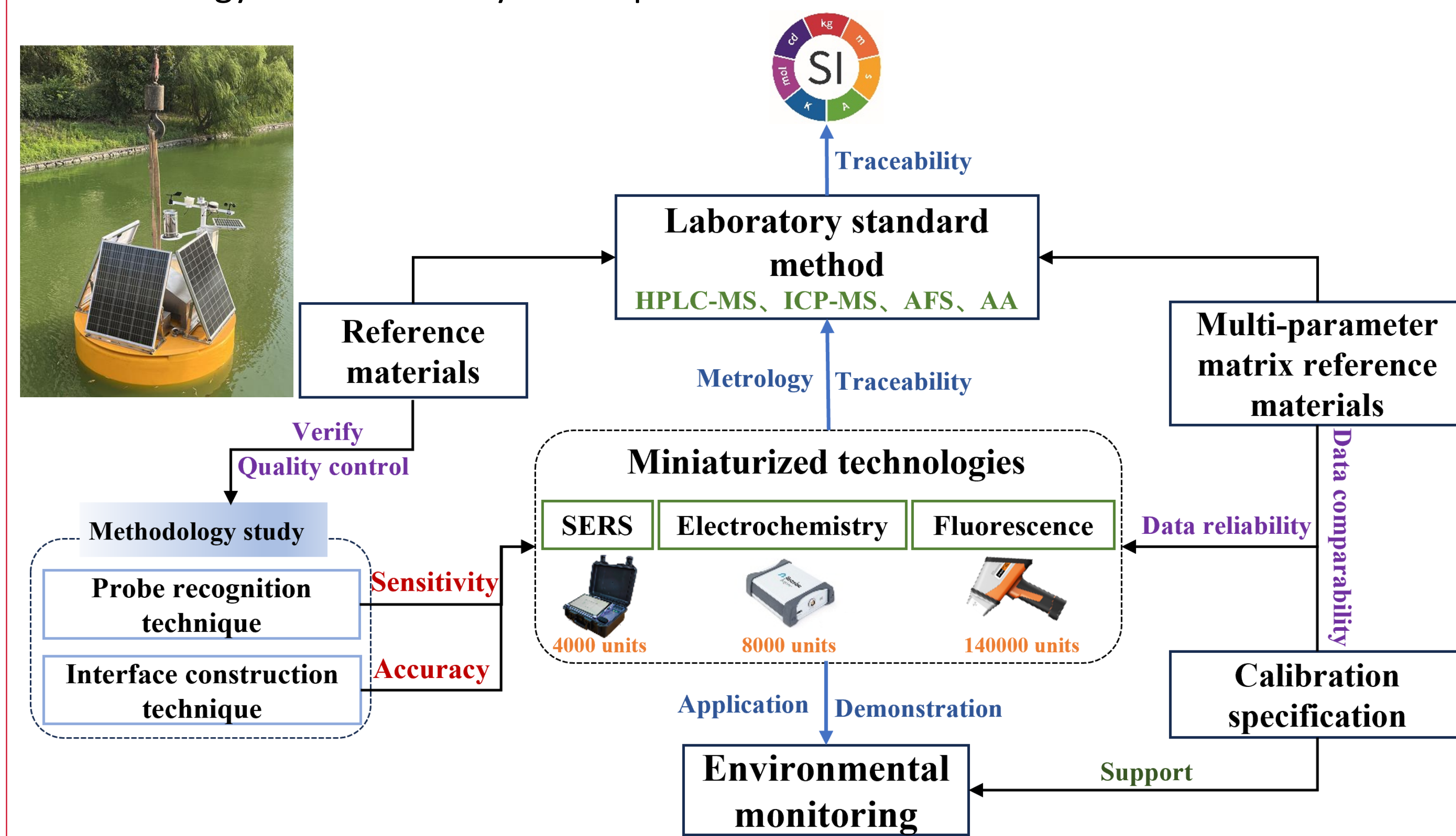


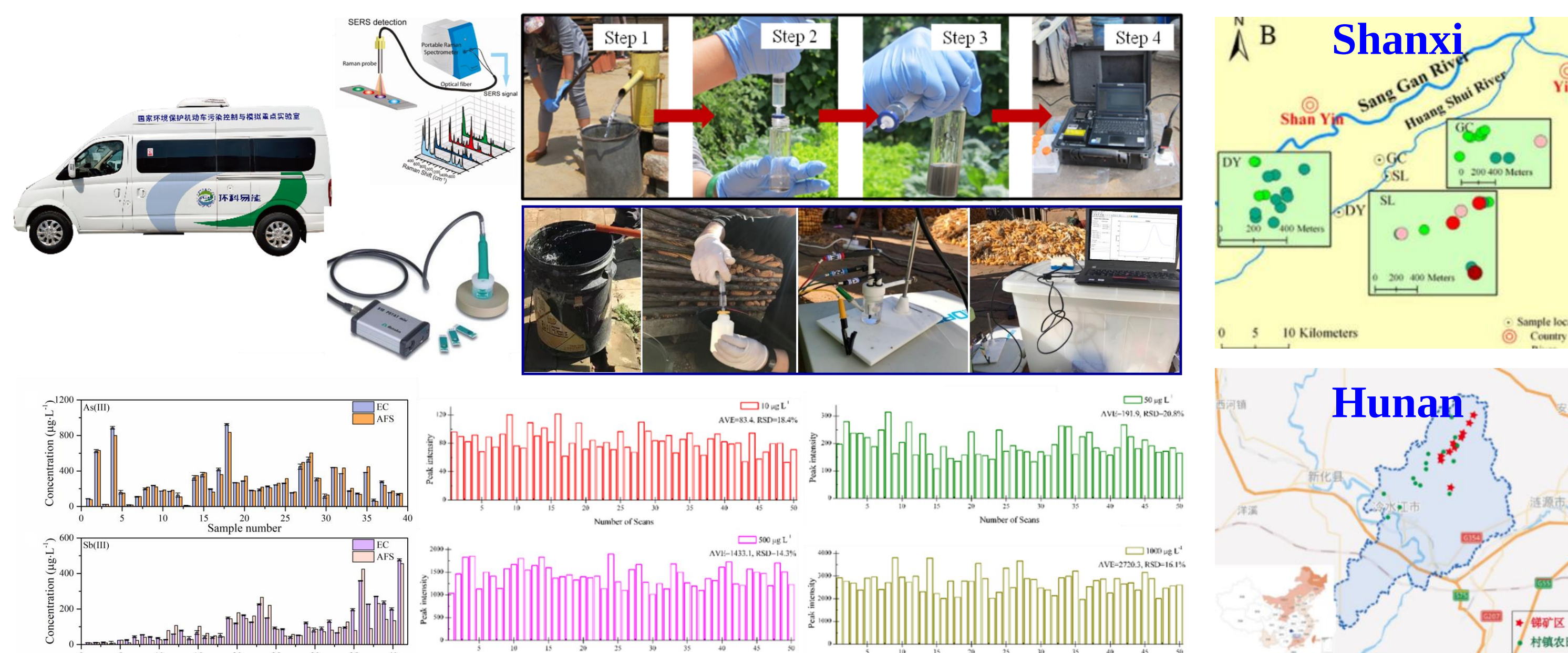
Introduction

Establishing reliable emission monitoring system for the aquatic environment is complicated by continued changes in pollutant levels and emerging of new pollutants. The field monitoring technique is required, because various environmental media play a significant role in the transport and transformation of pollutants. Miniaturized technology is promising to overcome challenges with the rapid acquisition of accurate data on environment quality. However, these technologies often lack metrological traceability and calibration strategies, and they have seldom been fully validated. The National Institute of Metrology (NIM), China has focused on developing SI-traceable miniaturized measurement of environmental pollutants through research on methodology and traceability techniques.



Application

With a solid technical foundation, miniaturized devices were installed on a mobile inspection vehicle. Beijing Yixingyuan Petrochemical Technology Co., Ltd. operates an SI-traceable miniaturized system to obtain initial values of pollutants in groundwater (Shanxi, China) and rivers (Hunan and Hebei, China). The indicating error of miniaturized devices is analyzed and calculated, which could reach below 20%.



Environmental Pollution

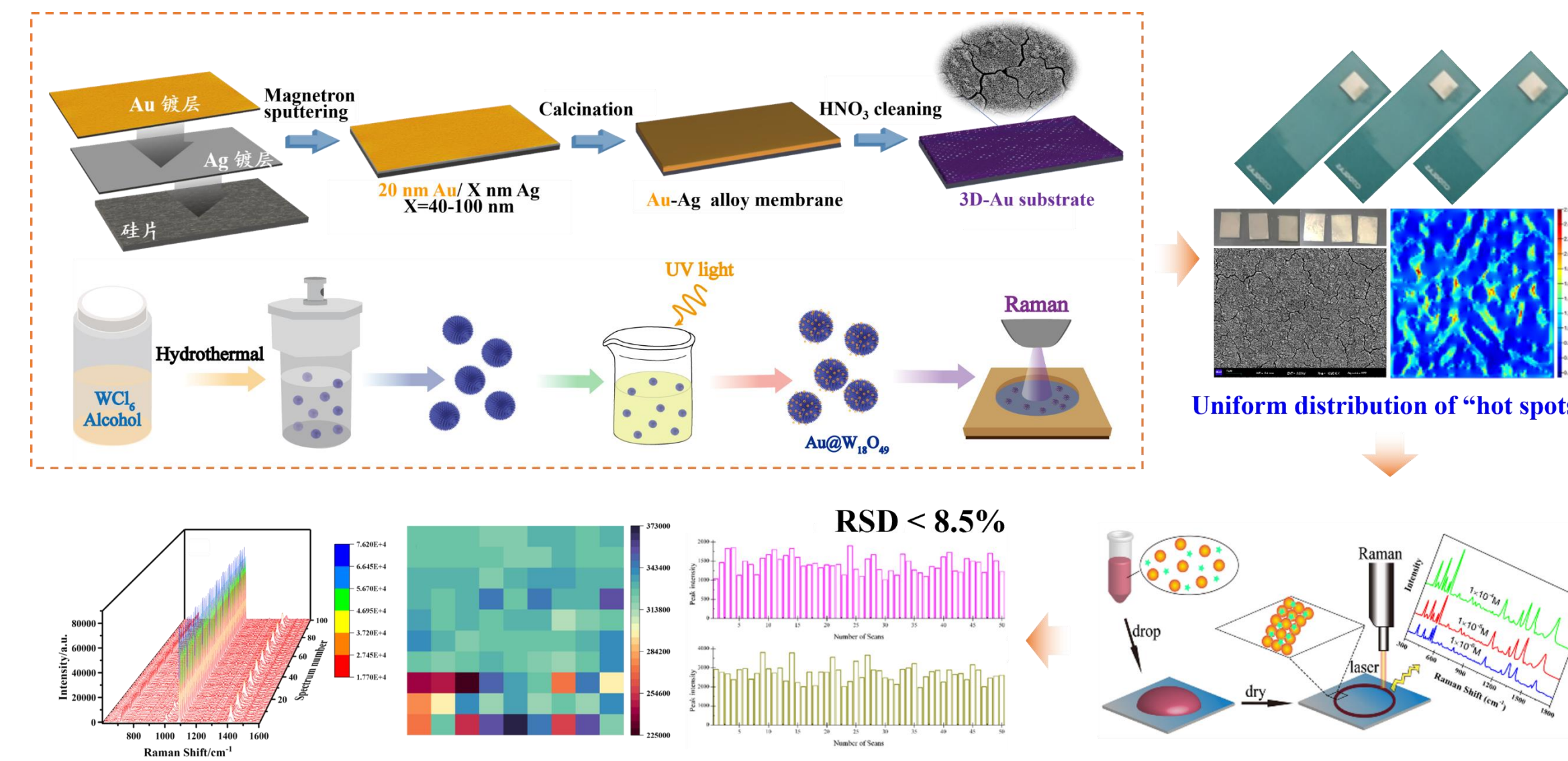
Yaqin Yu*, Xiaowei Song , Ke Li, Zhengdong Zhang

Center for Environmental Metrology, National Institute of Metrology China, Beijing 100029, China. Tel: 18201200761, Email: yuyq@nim.ac.cn

Results

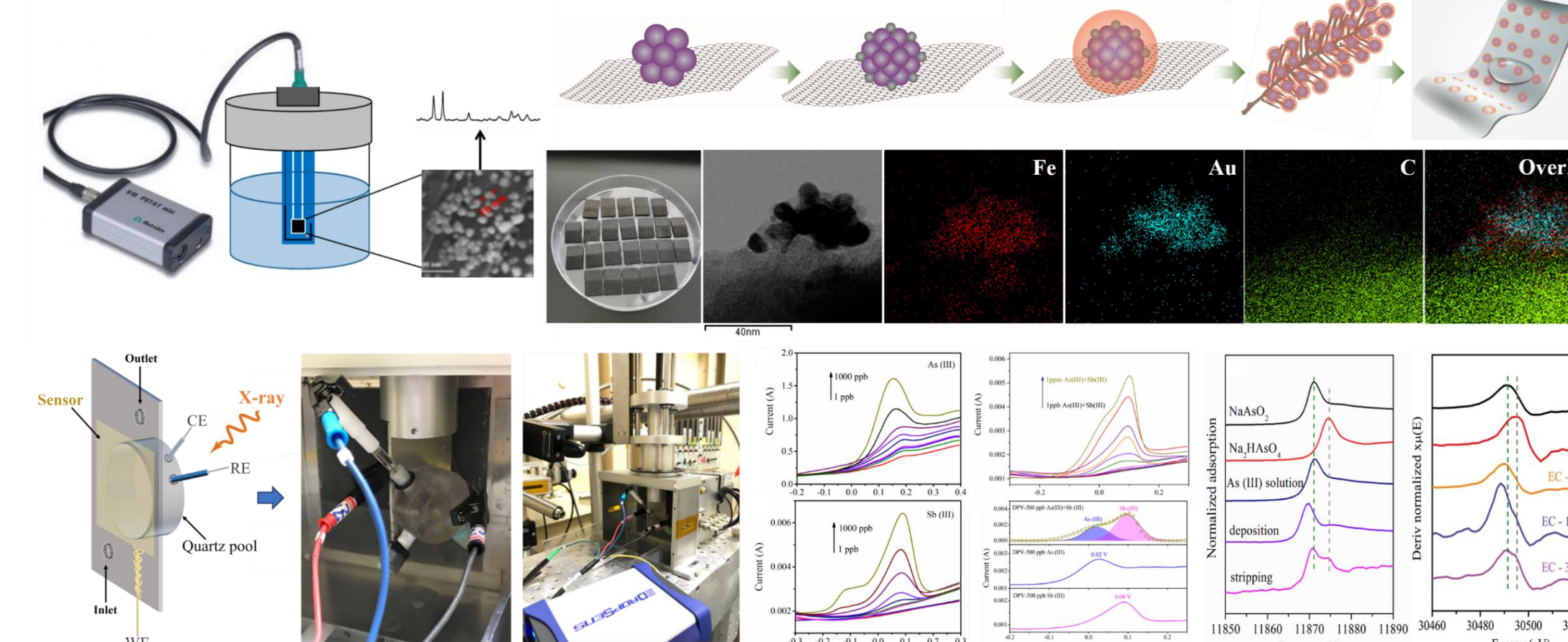
- Interface construction technique

Surface-enhanced Raman spectroscopy substrates were synthesized by the combined technology of magnetron sputtering and wet etching. This ensures accuracy of field-monitoring data with the uncertainty of less than 8.5%.



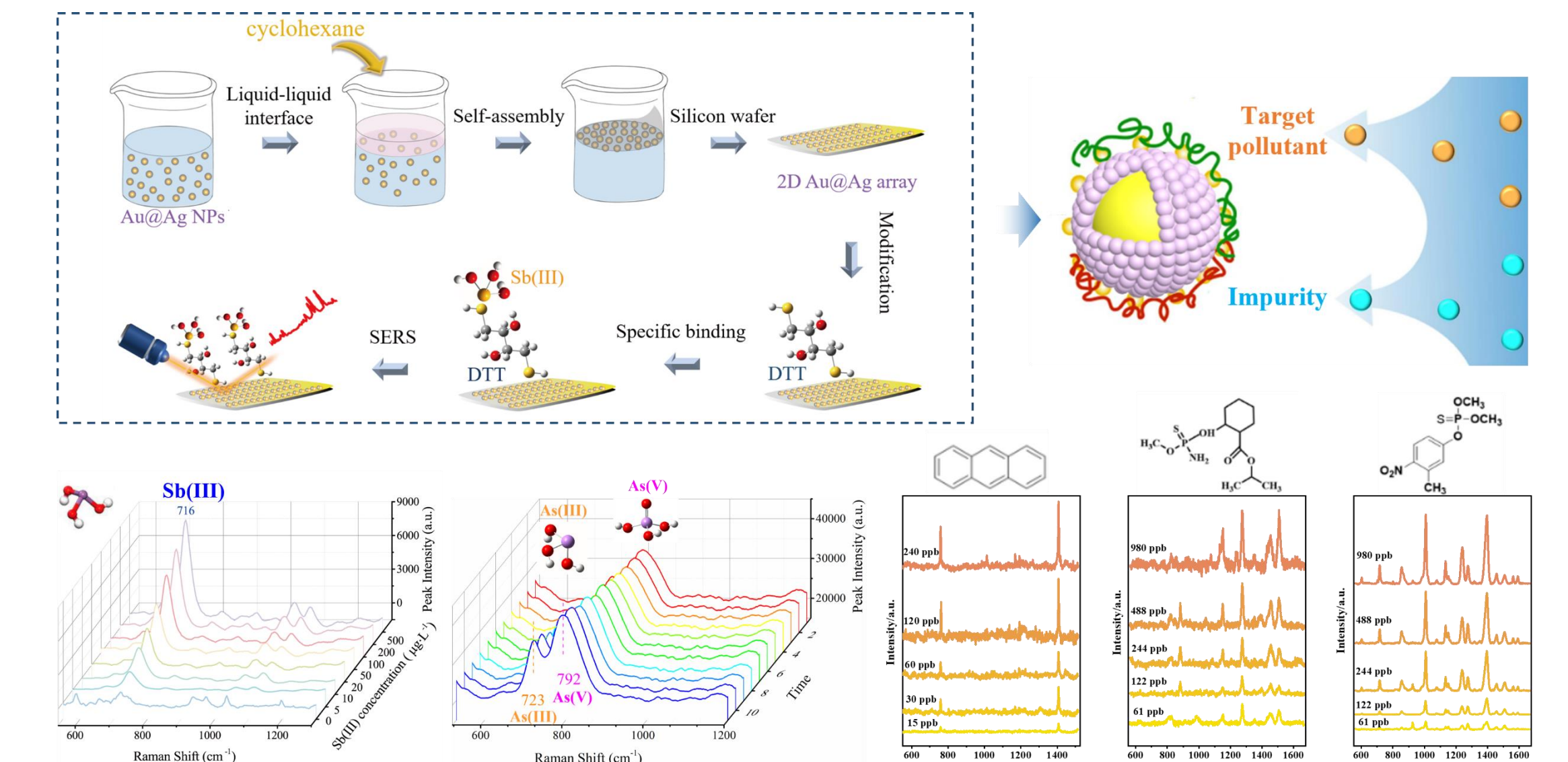
- Electrochemical-spectroscopy technique

A flexible sensor was developed using the electrodeposition technique, exhibiting good uniformity with relative standard deviations within 10%. The electrochemical-X ray technology was developed to detect pollutant species on the solid surface.



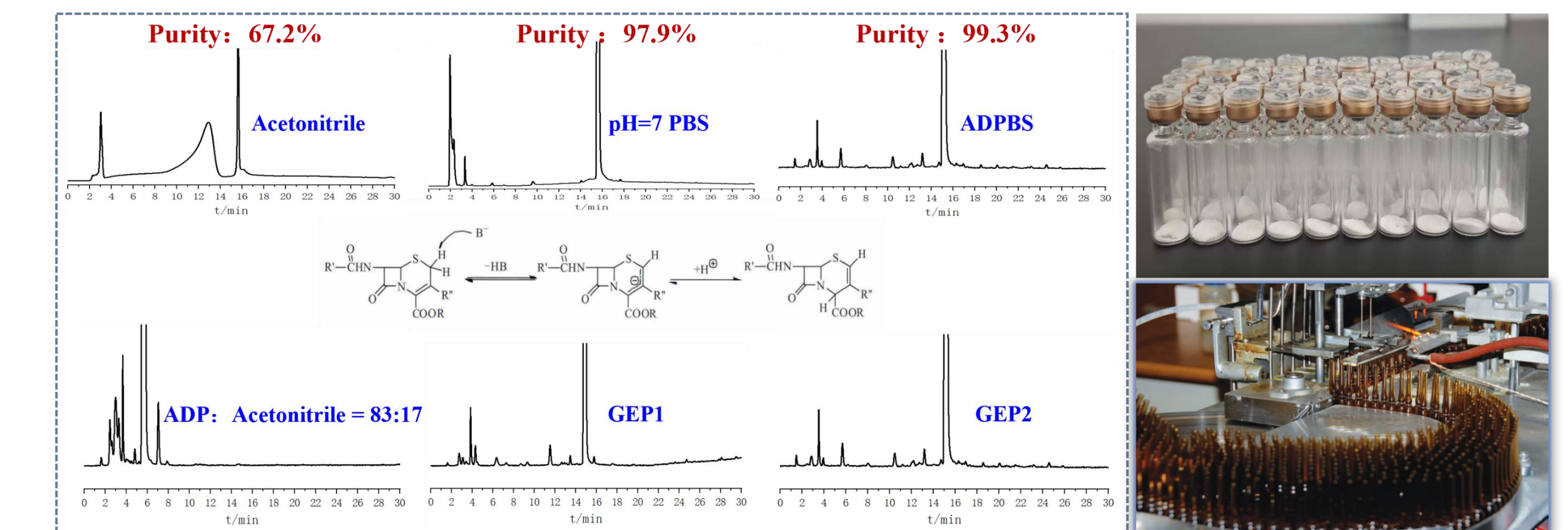
➤ Probe recognition technique

The efficient sensor was modified with organic functional groups. The targeted pollutants (Sb/As) were selectively enriched on sensor surfaces with a 1-3 $\mu\text{g}\cdot\text{L}^{-1}$ detection limit. The probe could be screened according to the different target objects.



➤ Reference materials

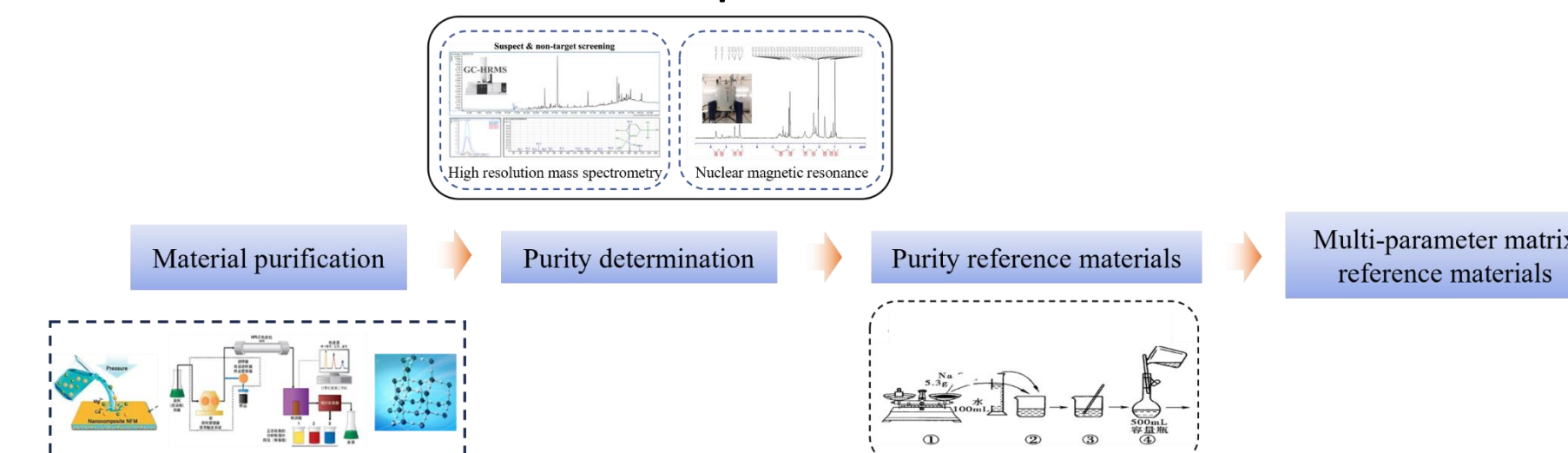
Reference materials of new pollutants were developed using the mobile-phase optimization technique and isomer quantitative technique of nuclear magnetism. These reference materials were used to support the establishment of miniaturized detection methods.



Outlook

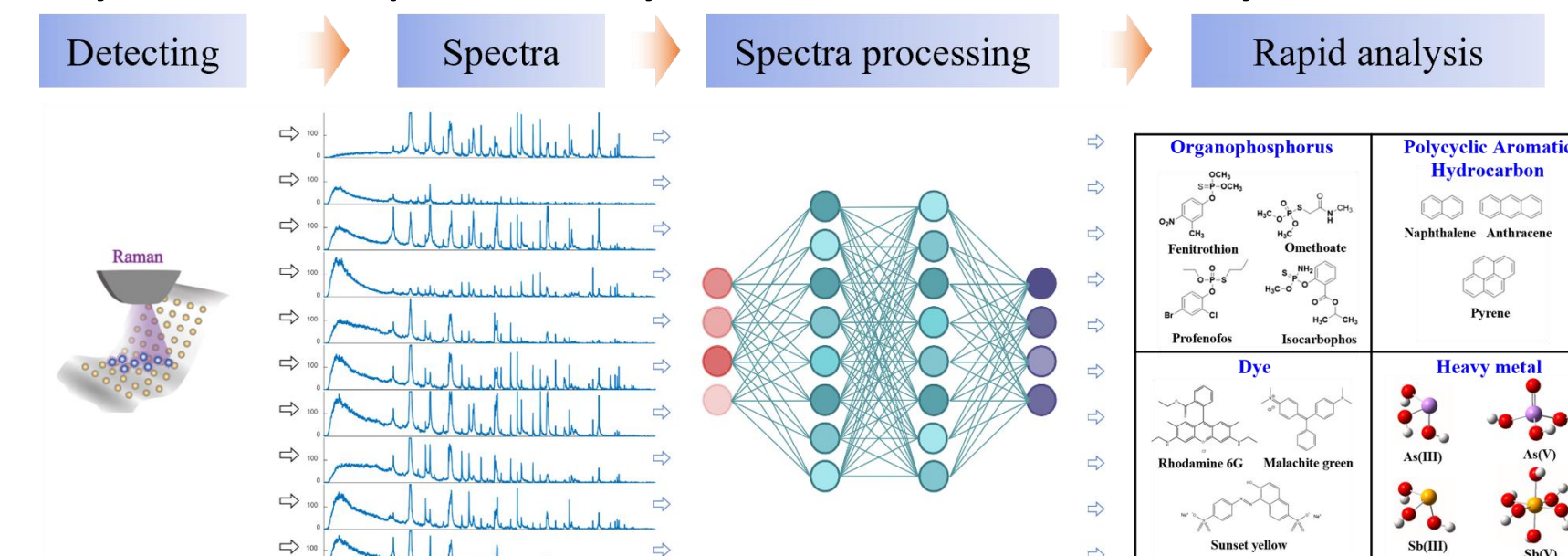
- Multi-parameter matrix reference materials

Based on the available purity standard materials, multi-parameter reference materials will be developed to establish an SI-traceable system of miniaturized techniques.



- Data processing model

Under the optimal conditions for spectral processing, the qualitative identification and analytical model will be developed to improve the accuracy and interpretability of miniaturized analytical methods.



Conclusion

- Interface construction technique was developed to synthesize the surface-enhanced Raman spectroscopy substrates with uniform surface, ensuring accuracy of field-monitoring data with the uncertainty of less than 8.5%.

- Probe recognition technique was developed to synthesize the efficient sensors with specific surface, raising the detection limit by an order of magnitude.

- The miniaturized devices were installed on a mobile inspection vehicle, obtaining the initial values of pollutants in natural water with indicating error below 20%.

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