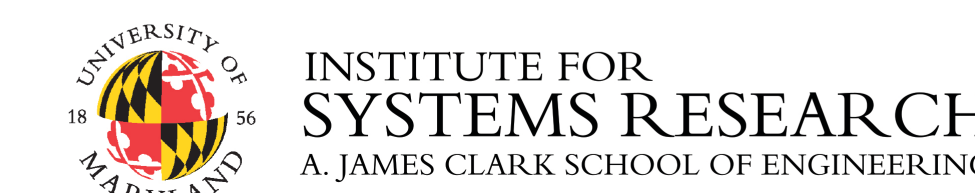


Inkjet-printed fluidic paper SERS devices for portable, on-site chemical analytics

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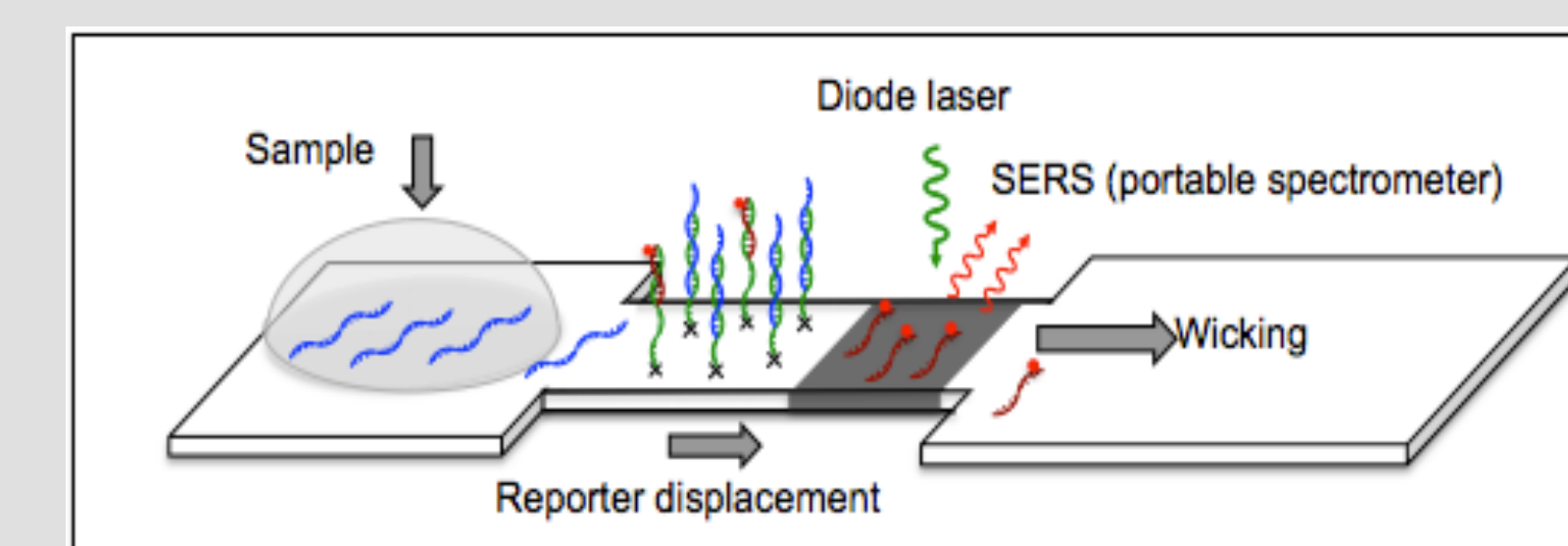
• Our approach to chemical sensing with surface enhanced Raman spectroscopy (SERS):

- SERS substrates fabricated on-demand by inkjet-printing metal nanoparticles onto paper (or other membranes).
- Paper is used for sample collection: dipsticks for liquid samples, surface swabs for trace residues.
- Lateral flow concentration of analyte molecules into the detection region using the inherent fluidic transport properties of paper.
- Analyte separation from complex samples using the chromatographic properties of paper and membrane materials.

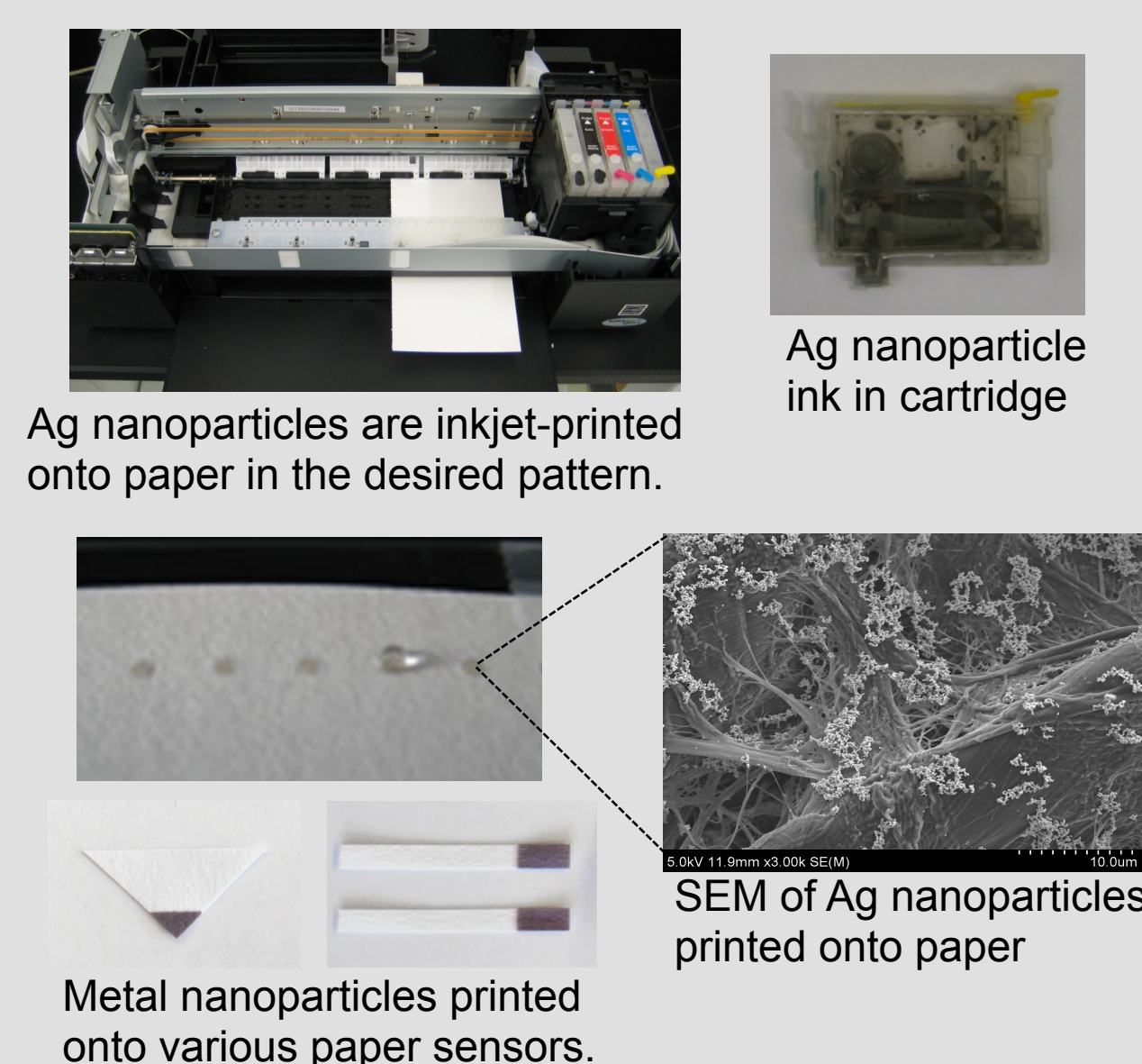
• The result: an on-site point-of-sample analytical platform with unprecedented cost and ease-of-use.

• Next steps: extend the technique to biosensing for lateral flow diagnostics.

- Recently demonstrated paper SERS for the multiplexed detection of PCR products.
- Recently demonstrated paper SERS for detection of DNA sequences using a low-cost easy-to-use cartridge for DNA sequence detection.
- In progress: single-step lateral flow detection of protein biomarkers using aptamers.



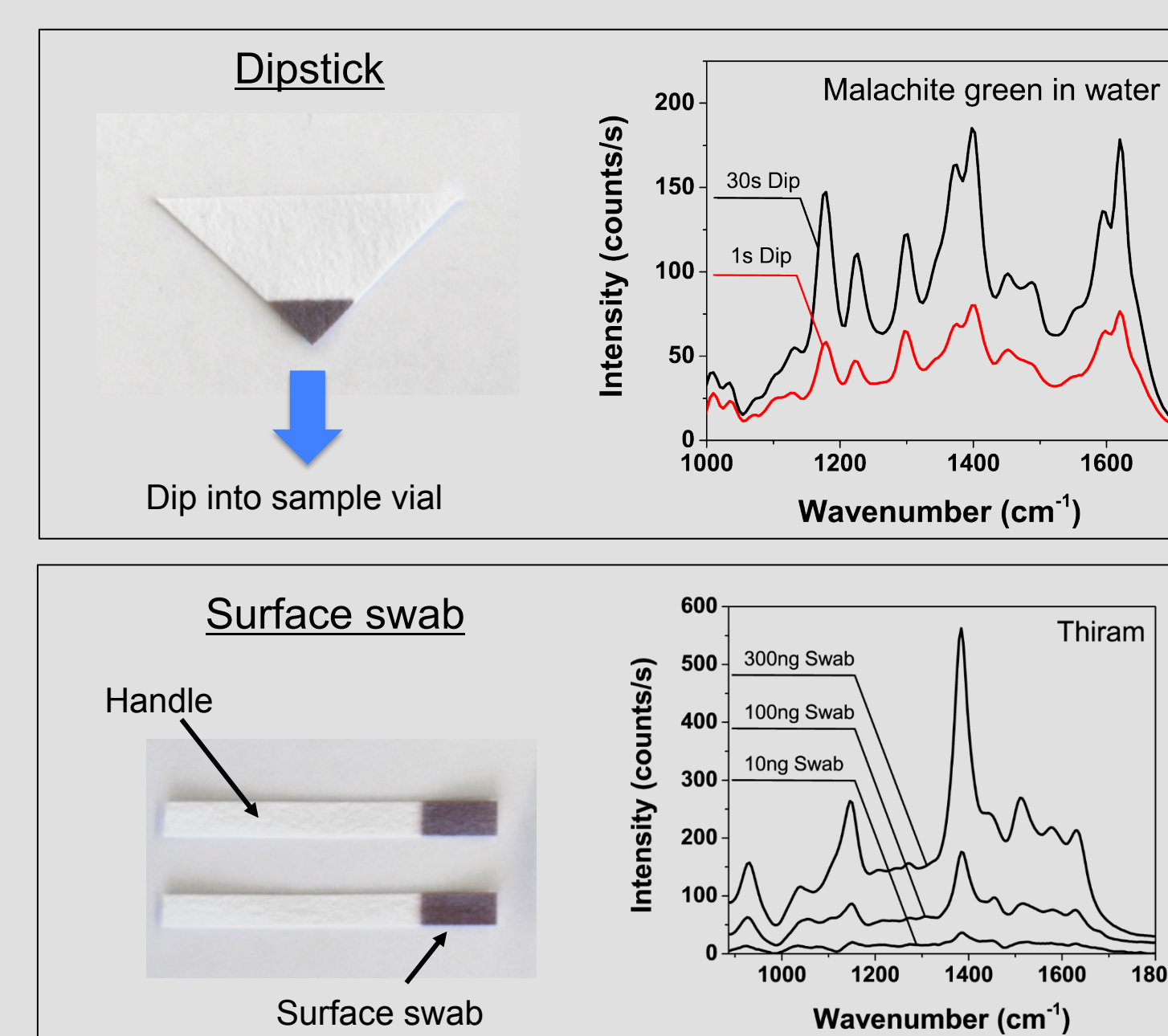
Paper SERS device fabrication



- Paper-SERS substrates are formed by inkjet printing Ag or Au nanoparticles onto paper or membranes.
- Ink is formed from concentrated nanoparticle colloid.
- Loaded into re-usable cartridges.
- Hydrophobic modifiers can be printed to prevent or to guide wicking.
- Printed by low-cost consumer printer with piezo inkjet head.

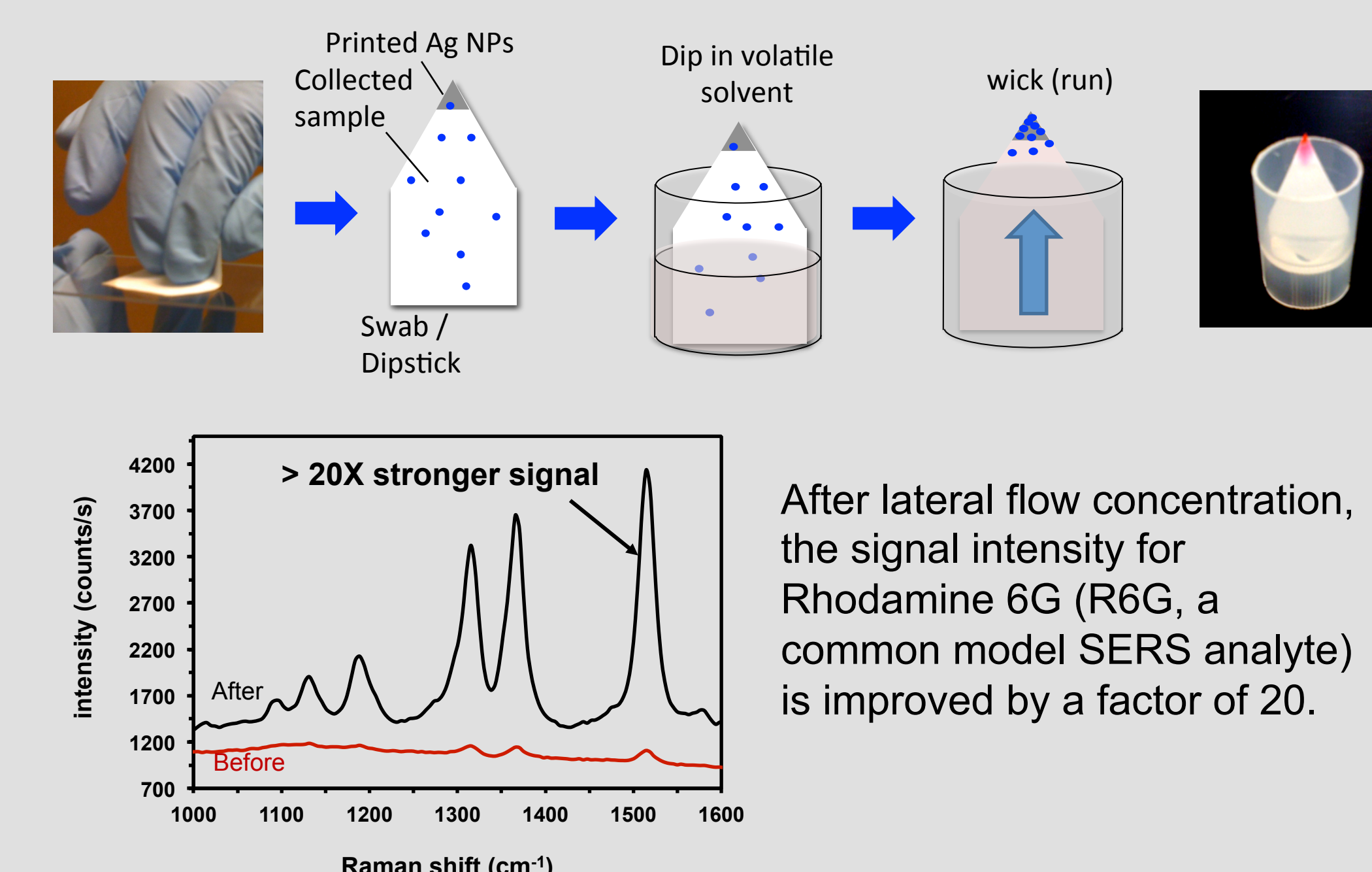
Paper SERS sensors as dipsticks and surface-swabs

- In addition to the cost benefit, paper provides tremendous advantages as a SERS substrate in terms of sample collection.
- For liquid samples (e.g., water analysis):
 - Sample can be collected by dipping the paper sensor directly into the water.
- For trace residue on surface:
 - Sample can be collected by swabbing the paper across the surface.
 - Analyte from a broad surface is collected onto a small sensor.



Fluidic lateral-flow concentration with paper SERS sensors

- Following sample collection onto the paper SERS device, analyte molecules can be concentrated into the small sensor area with a simple dip.
- Volatile solvent is drawn across the paper by capillary forces and evaporation.
- Mobile solvent transfers analyte molecules along the paper strip to the sensor.
- Concentrates analyte molecules from the entire area of the paper into a small region that is interrogated by the laser.
- Lateral flow concentration step provides significant performance enhancement.



After lateral flow concentration, the signal intensity for Rhodamine 6G (R6G, a common model SERS analyte) is improved by a factor of 20.

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