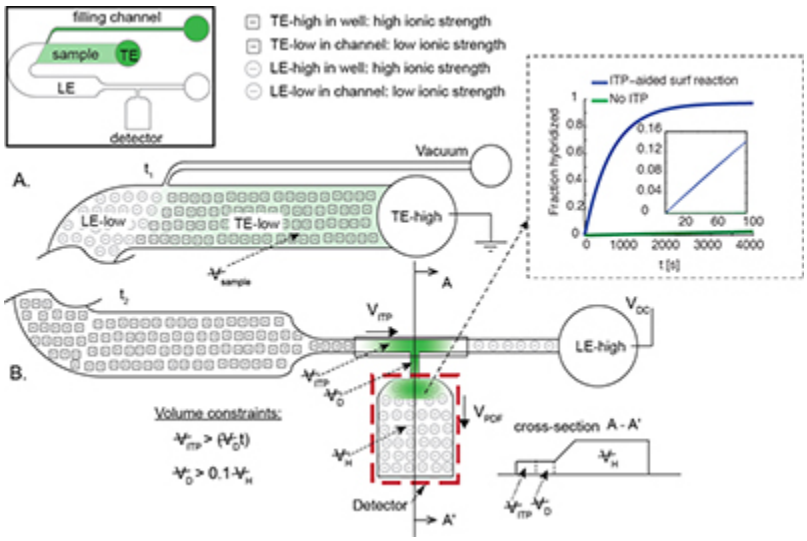
Docket #: S16-005

A Method for Faster, Sensitive Biomolecular Detection in Surface Reaction Assays

Stanford Prof. Juan Santiago and a team of engineers have developed a method of speeding up chemical reactions between a probe on a surface and a molecule in solution. They use isotachophoresis (ITP) to preconcentrate biomolecules in solution and then automate transport of the ITP-focused target molecules onto a region of probes immobilized onto a surface. For example, they use ITP to focus and then transport the ITP-focused species onto a metallic surface for Surface Plasmon Field Enhanced Fluorescence Spectroscopy (SPFS). In complex samples, the ITP purifies and 'pre-concentrates' the target analytes. The concentrated sample can then be delivered to a SPFS sensor for ultra-rapid detection – the capture molecules in the SPFS sensor bind the ITP-focused targets. The result is a much faster (30x faster) and more sensitive detection (almost 10x) of biomolecular analytes for bioassays, such as immunoassays and nucleic acid hybridization arrays.

Stage of Research
The inventors successfully built and tested the microfluidic chip that integrates ITP with SPFS, and demonstrated feasibility of integrating ITP with surface reaction assays that use conductive surfaces.



Schematic of microfluidic device integrating ITP and a surface sensor (e.g., SPFS)– Two reservoirs contain a low-mobility trailing electrolyte buffer and a high-mobility leading electrolyte buffer to use ITP to focus target biospecies. The main fluid channel bridges the two reservoirs and transports the ITP-focused molecules to the entrance of a side channel for the surface detector. Pressure driven flow is then used to transport the ITP-focused molecules onto the metallic surface of the surface plasmon sensor.

Applications

- **Bioassays** and **molecular diagnostics**, such as immunoassays, or DNA and RNA hybridization assays.

Advantages

- **Faster and more sensitive** - ITP speeds up chemical reactions between molecules in solution and molecules immobilized on a metallic surface. The resulting reaction time decreases by an order of magnitude, while sensitivity increases by an order of magnitude.

Publications

- Yamamoto, Noriaki, Juan Santiago, and Denitsa Milanova. "Detection of biological molecules using surface plasmon field enhanced fluorescence

spectroscopy (spfs) combined with isotachophoresis (itp)." U.S. Patent Application No. 15/071,714.

Patents

- Published Application: 20160209407

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