NANOPARTICLE DETECTION OF ILLICIT DRUGS

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Abstract: We report on an ongoing project to detect illicit drugs with an immunoassay developed around silver nanoparticle technology and portable Raman systems. The particular assays that we will be reporting on are a competitive assay using resonance Raman active reporters.

The abuse of illicit drugs is a widespread problem in the United States. When coupled with the risks associated with transmission of potentially lethal infectious diseases, drug testing represents a significant medical problem. Our project narrows the focus of drug testing to that of juvenile offenders. The population of adolescent drug users continues to rise significantly and timely drug testing will facilitate in the treatment and management of these individuals (1).

Drugs can be detected with Enzyme Linked ImmunoSorbant Assays (ELISA). However, this method involves introduction of samples, followed by a wash step, introduction of reporter, and again a wash step. The wash steps have several disadvantages, foremost is the spread of sample through spray and dilution. Illicit drug abusers often carry lethal diseases due to IV drug abuse and the amplification of sample contamination through washing is a serious problem. An additional disadvantage is the loss of equilibrium due the washing steps. Our approach uses the spatial localization of the SERS effect to eliminate signal from unbound reporter and to remove matrix interferences.

The SERS effect is localized to within a few nanometers from the surface. This strong local distance dependence arises from the induce dipole- induced dipole nature of the SERS effect. In fact, since both the input (excitation) electric field and the output (Raman induced dipole) are enhanced the distance dependence is squared. This phenomenon has allowed us to develop an assay that eliminates washing steps and enhances the Raman signal through SERS and resonance Raman scattering.

Figure 1 shows a typical spectral response and assay cross-validation plot for simultaneous detection of methamphetamine and morphine (2). Two monoclonal antibodies coupled with two different dye tagged reporters allowed us to detect two analytes simultaneously.

Figure 2 shows an example of one of our dye tagged reporters for methamphetamine. The dye portion of the reporter is an azo dye (3). The dye is attached to a methamphetamine analogue though the methamphetamine amine group and an alkyl chain.

Figure 1 Simultaneous binary SERIA™ detection of methamphetamine and morphine in saliva matrix. PLS cross-validation plot of both species.

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The instrumentation used for this analysis is a small low-cost Raman system operating with a 633 nm HeNe laser. We will also discuss methods for further miniaturization of Raman systems using diode laser excitation.

### Scheme 2
Synthesis of the new drug analog reporter for methamphetamine, 7.

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**References:**