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Introduction

Matrix-assisted laser desorption/ionisation time-of-flight mass spectrometry (MALDI-TOF-MS) is a very important and successful analytical technique for a wide variety of samples. Generally, sample preparation involves placing a sample/matrix solution onto a sample target, and then allowing the solvent to evaporate. This technique relies on sample and matrix combinations that are soluble in the same, low boiling point, solvent or miscible solvents. However, a significant number of samples submitted to the NMSSC are insoluble or only soluble in high boiling point solvents e.g. DMSO. Additionally, some samples are unstable in solution. The development of solvent-free sample preparation methods is clearly beneficial to the NMSSC and the wider scientific community. Previous work in this area has focused mainly on synthetic polymers, but has also been applied to biochemical samples.

Deposition of Mixture onto Plate

1. Pressed disc: Sample/matrix mixture was pressed into a die and pressed apparatus normally used to press KBr discs for IR measurements. 10 tonnes of pressure were applied. The discs were very fragile, especially TCNQ discs, making handling difficult.

2. Pressed disc with KBr. KBr was added to the mixture in molar ratios of 2:1, 1:1, 0.5:1, 0.25:1 and 0:1, with respect to the matrix, in order to attempt to improve the structural integrity of the pressed disc. Additionally, promoting the formation of [M+K]+ species was sought.

3. Suspension in non-solvent: Sample/matrix mixture was suspended in 0.5 mL of water by vortex mixer until judged by eye to be homogeneous, which was approximately 3 minutes.

4. Dabbing.

5. Double-sided adhesive tape.

Results

Comparison of data acquired for V(II)(acac)/DCTB.

While the expected species was observed by most deposition methods, this was not the case for the suspension and adhesive tape methods. The dabbing method appears the cleaner, higher for the suspension and adhesive tape methods.

Discussion

Samples and matrices were mixed in molar ratios of 1:50, 1:75, 1:100, 1:200, 1:500 and 1:1000.

1. Pestle and mortar: Portions of sample and matrix were ground until the mixture was judged by eye to be homogeneous, which was approximately 3 minutes.

2. Steel ball milling: Portions of sample and matrix were added to a plastic, cone-shaped, sample vial. A 3 mm steel ball was added and the mixture ground by agitating the vial with a vortex mixer until judged by eye to be homogeneous, which was approximately 1 minute. The method of Hanton and Parees uses 2 balls, but 1 appears to be sufficient.

Comparative data was acquired for each method of solids mixing, regardless of the method of application on the sample plate. However, steel ball milling was quicker, cleaner and a less labour intensive process, and so judged to be the better method.

Further Work and Conclusions

Our ‘ball mill and dab’ solvent-free method was applied to a selection of poorly soluble or insoluble samples. These samples have already been analysed by solid EI/CI, and the results achieved by MALDI were comparable. Identical results for solvent-free MALDI and solution MALDI were observed for a series of organometallic samples, which are known to degrade in solution.

The ‘ball mill and dab’ method was judged to be the most effective and efficient. Pressed discs were also effective, with cationisation promoted when salt was incorporated. Optimum balance of disc integrity and good data was obtained with salt/matrix mixtures of 0.5:1 or 1:1. Very poor data were produced by non-solvent suspension and adhesive tape methods. The best quality data were achieved with sample/matrix mixtures of 1:75 or 1:100. The minimum amount of sample required to produce meaningful data, while maintaining ease of handling, was approximately 0.08 mg.

References


