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Progress toward accurate chemical measurements of thin organic films using cluster ion beam sputtering

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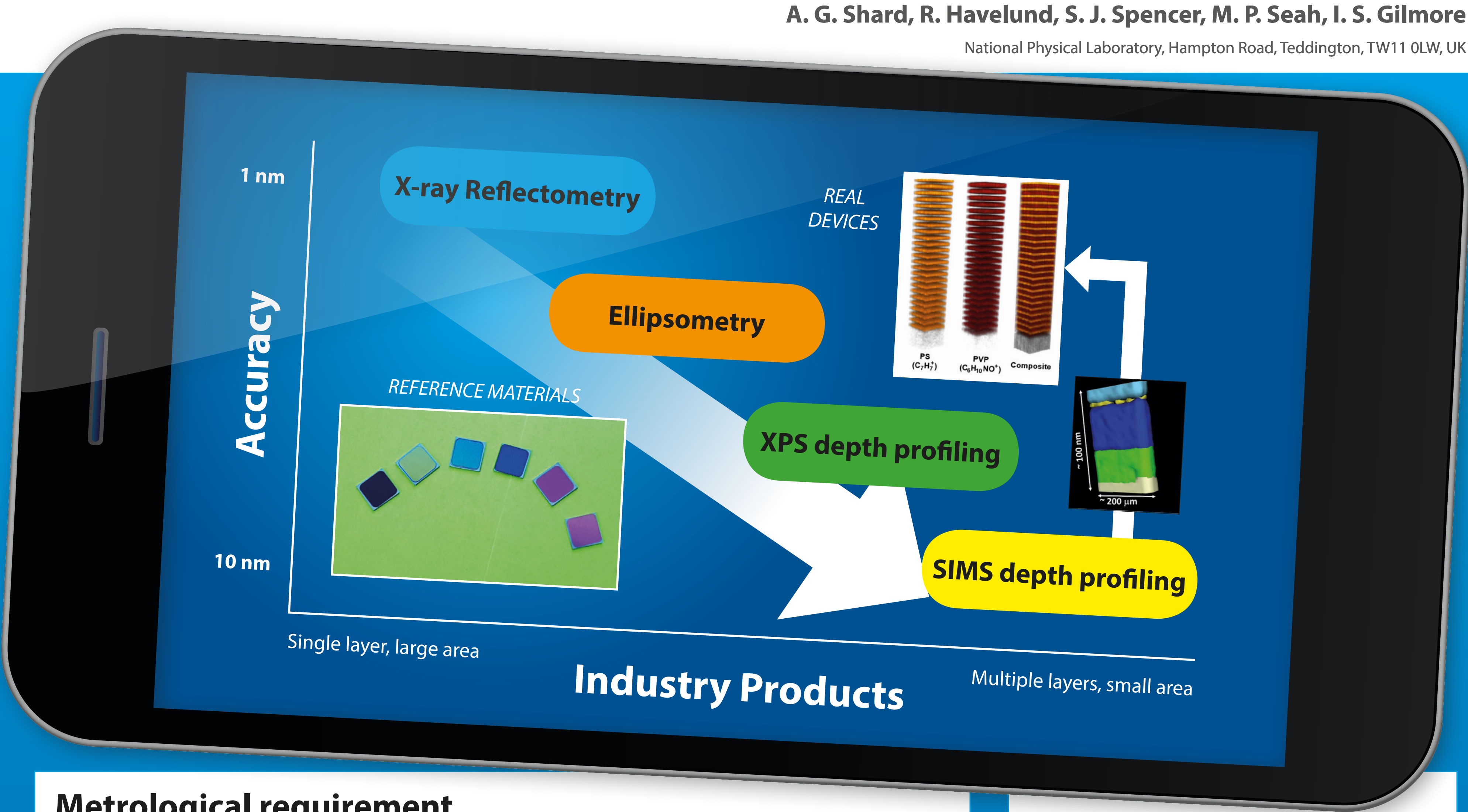
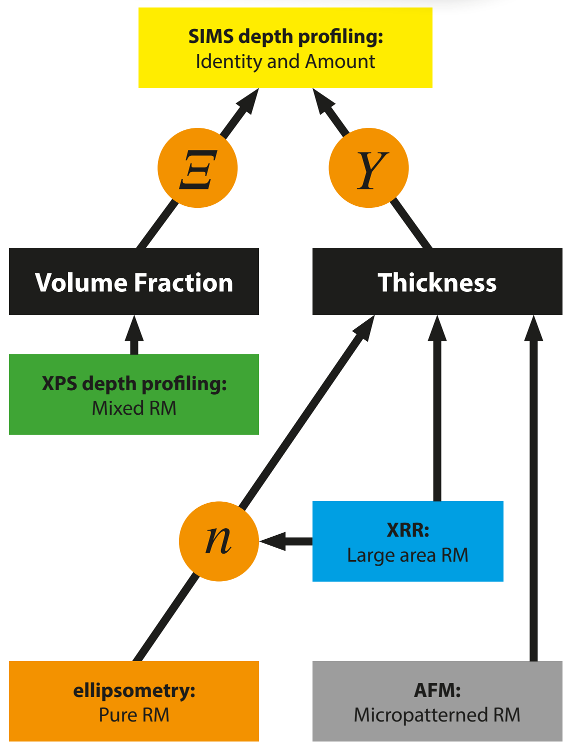


Metrological requirement

Layered and structured organic materials are increasingly employed in displays, photovoltaics, drug delivery systems and optical devices. Structures with ~100 nm thickness with lateral dimensions of ~100 µm are common. The analytical method of choice for industry is SIMS depth profiling to provide: material identification, sensitivity to contaminants and dopants and, spatial resolution. Depth profiling provides a relative measure of thickness but the accuracy is unknown.

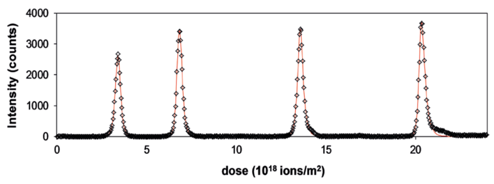
Reference Materials

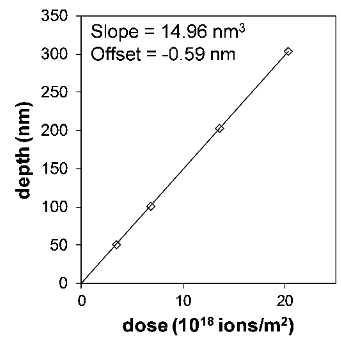
NPL has generated a range of reference materials using physical vapour deposition. These have sufficient uniformity for all measurement techniques. For single-layer organic films >20 nm thick, ellipsometry provides thicknesses within 2% of XRR thicknesses. [1]



Sputtering yield

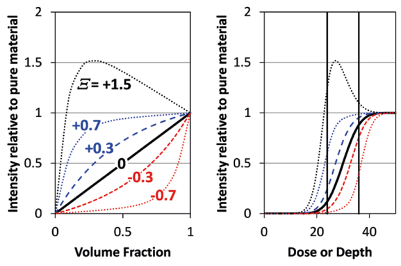
Argon cluster beams demonstrate constant sputtering rates, excellent depth resolution. [2] Excellent precision in the measurement of yield is possible.

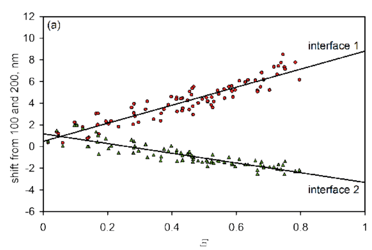




Interface position

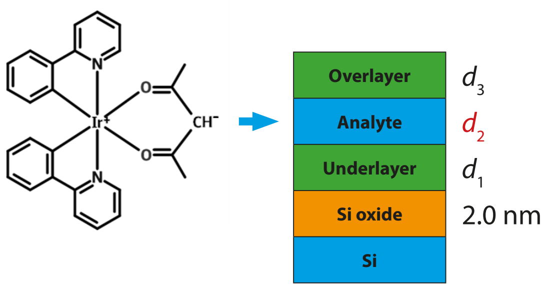
Requires knowledge and description of matrix effects [3] as well as physical processes such as roughness. Methods now available to reduce uncertainty to acceptable (<2 nm) levels [4].





Proposed Pilot Study

Measurand: the amount of Ir(ppy)$_2$(acac) in a buried layer expressed as thickness [5].



References

[1] J Wernecke, AG Shard, M Krumrey, Surf. Interface Anal. 46, 911 (2014)
[2] AG Shard, R Havelund, J. Phys. Chem. C 84, 7865 (2012)
[3] AG Shard *et al*, Int. J. Mass Spectrom. 377, 599 (2015)
[4] R Havelund *et al*, J. Am.Soc. Mass Spectrom. 29, 774 (2018)
[5] MP Seah et al, J. Am.Soc. Mass Spectrom. 30, 309 (2019)