Dynamic, *In Situ*, Magneto-Optical Studies of Co-Pt Multilayers

R. Atkinson, W.R. Hendren, G. Didrichsen, R.J. Pollard, and I.W. Salter

Department of Pure and Applied Physics, The Queen's University of Belfast, BT7 1NN, Northern Ireland, UK

Both optical and magneto-optical studies have been made of the deposition of ultra-thin Co and Pt multilayers onto glass substrates having a Pt buffer layer. Real-time magneto-optic monitoring, using Kerr polarimetry, enabled us to monitor the growth of these systems in considerable detail and to compare the results with calculations based on inhomogeneously magnetised systems. *In situ* measurements of the polar Kerr rotation and ellipticity of growing layers, as shown in figure 1, allowed the direct observation of fundamental differences in the interfacially induced polarisation of Pt. Results appear to indicate that the polarisation depends strongly on the sequencing of the elemental materials. That is, whether the interface is Co-Pt or Pt-Co. Experiments also show that there is a gradual deterioration in the polarisation of the platinum layer as the deposition process proceeds. To our knowledge, such direct observations have not been reported before. There could be major implications for the results reported in this work. First, at the fundamental level, the data gives important insight into the nature and extent of the interfacial magnetism of practical systems. Second, our observations indicate that there may be considerable potential for improvement in the magneto-optical performance of these systems. This arises for two reasons. First, we reported previously [1] that the decay of polarisation of Pt is exponential. If this occurs only at the interface of Co followed by Pt, and not *visa versa*, a clear improvement in MO performance can be made if the system can be made symmetrical. Second, there are indications of a decrease in MO performance of the multilayer system as the over-all thickness increases. This degradation in performance is significant and occurs after a few bi-layer spacings. It is believed that this is due to deterioration in the quality of the inter-atomic ordering as the total system increases in thickness.

![Graph](image-url)  
**Fig. 1.** Evolution of the polar Kerr effect for 10 x Co/Pt(0.5/3.0nm) multilayer.
In addition to the magneto-optical data we will also report on the optical signatures associated with the monitoring of the deposition of the complete multilayer system. Amongst other things, we will report on an apparent spurious rotations that occur during the initial deposition of the Pt buffer layer. Such signatures, illustrated in figure 2, were not expected and are not easily explained. The apparent rotations are large and are clearly not magneto-optic origin. Furthermore, we also report on the variation in reflectivity of the system during its deposition. A typical profile is shown in figure 3. and may be modelled in terms of the optical properties of the constituent materials. It is intended to comment on these optical observations and also to discuss possible alternative explanations of the observed magneto-optical data.

References