

Contents

| | | |
|----------|-------------------------------------------------------------------------|-----------|
| 1 | Introduction | 3 |
| 2 | Fundamental Aspects | 9 |
| 2.1 | Electronic structure of 3d ferromagnets | 10 |
| 2.1.1 | Ferromagnetism of 3d transition metals | 10 |
| 2.1.2 | Spin-split electronic bands | 12 |
| 2.1.3 | Excursus: Symmetry and electronic structure | 14 |
| 2.2 | Spin- and Angle-Resolved Photoemission Spectroscopy | 16 |
| 2.2.1 | The three step model | 16 |
| 2.2.2 | The photoexcitation process | 18 |
| 2.2.3 | Spin-resolved photoemission from ferromagnets | 20 |
| 2.2.4 | Basic ideas of spin-density functional theory | 23 |
| 2.3 | Electronic structure and spin polarization in FM/I systems | 24 |
| 2.3.1 | Spin dependent transport | 25 |
| 2.3.2 | Bandstructure and TMR | 27 |
| 2.3.3 | Beyond simple FM/I/FM model systems | 30 |
| 3 | Experimental Methods | 33 |
| 3.1 | Layout of the experiment | 33 |
| 3.2 | Molecular beam epitaxy | 34 |
| 3.3 | Structural, magnetic and chemical characterization techniques | 36 |
| 3.3.1 | Low energy electron diffraction (LEED) | 36 |
| 3.3.2 | Magneto-optical Kerr Effect (MOKE) | 36 |
| 3.3.3 | Auger electron spectroscopy (AES) | 37 |
| 3.4 | Operating the spin- and angle-resolved PES experiment | 40 |
| 3.5 | Core-level photoemission spectroscopy | 43 |
| 4 | Sample Preparation and Characterization | 47 |
| 4.1 | GaAs substrate preparation | 48 |
| 4.2 | Fe growth on GaAs(001) | 50 |
| 4.2.1 | Magnetism of Fe/GaAs(001) | 52 |
| 4.3 | Co growth on Fe/GaAs(001) | 53 |
| 4.4 | Ultrathin MgO _x on Fe(001) and Co(001) | 55 |
| 4.5 | Summary | 59 |

| | |
|-------------------------------------------------------------------|-----------|
| 5 Electronic Structure of Fe/MgO and Co/MgO | 61 |
| 5.1 Introductory remarks | 62 |
| 5.2 The MgO _x /Fe(001) interface | 63 |
| 5.2.1 Electronic structure of bcc-Fe(001) | 63 |
| 5.2.2 Electronic structure of MgO _x /Fe(001) | 67 |
| 5.2.3 Interface chemistry and spin polarization | 78 |
| 5.3 The MgO _x /Co(001) interface | 79 |
| 5.3.1 Electronic structure of bcc-Co(001) | 79 |
| 5.3.2 Electronic structure of MgO _x /Co(001) | 82 |
| 5.4 Summary | 85 |
| 6 Conclusions and Outlook | 87 |