Spin-Transfer-Torque MRAM

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I. INTRODUCTION

Spin-Transfer-Torque MRAM was invented at IBM by John Slonczewski in the early 1990s.[1] By using a spin-polarized current, instead of a magnetic field, to write a magnetic free layer in a magnetic tunnel junction, the required write current naturally decreases with area, providing attractive technology scaling.[2,3] The discovery of high magnetoresistance in MgO tunnel barriers at IBM by Stuart Parkin,[4] and later independently by Shinji Yuasa,[5] enabled sufficient read signal to efficiently read magnetic tunnel junctions. The discovery of perpendicular magnetic anisotropy in thin CoFeB/MgO layers at IBM [6] and independently by Tohoku University [7] enabled a dramatic reduction in the switching current, and opened the way to practical perpendicular magnetic tunnel junctions for dense Spin-Transfer-Torque MRAM.[8]

II. LOW SWITCHING CURRENT

In order for MRAM to become a mainstream technology, it is required to reduce the switching current, in order to reduce the size of the access transistor required, and therefore increase the number of bits that can be packed onto a chip. This talk will discuss our recent results at IBM on methods to lower the switching current of Spin-Transfer-Torque MRAM and achieve low write-error-rate by using optimized magnetic materials [9,10] and double magnetic tunnel junctions [11,12].

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