Low Damping in Spinel Ferrite Thin Films Enabled by Chemical Substitution\textsuperscript{1} SATORU EMORI, MATTHEW GRAY, SAMUEL CROSSLEY, URUSA ALAAN, ADRIAN SWARTZ, Stanford University, BENJAMIN GRAY, Air Force Research Laboratory, HYUNG-MIN JEON, Wright State University, HAROLD HWANG, Stanford University, BRANDON HOWE, Air Force Research Laboratory, YURI SUZUKI, Stanford University — Spinel ferrites are versatile magnetic insulators whose properties can be tuned by chemical substitution of their constituent elements. However, it has been a challenge to realize spinel ferrite thin films with sufficiently low damping for emerging spintronic applications. We achieve low damping in spinel ferrite films by substituting a large fraction of Fe with Al. Films of thickness $\approx 25$ nm and nominal compositions $\text{Ni}_{0.65}\text{Zn}_{0.35}\text{Al}_x\text{Fe}_{2-x}\text{O}_4$ are grown on single-crystal $\text{MgAl}_2\text{O}_4$\,(001) substrates by pulsed laser deposition. Fully coherent growth of Ni-Zn ferrite ($x=0$) on $\text{MgAl}_2\text{O}_4$ is elusive due to the large substrate-film lattice mismatch of $>3\%$. High concentrations of Al ($x \geq 0.5$) decrease the lattice constant of the ferrite such that the films are fully strained to the substrate and highly crystalline. As the Al concentration is increased from $x=0.5$ to 1.0, the Gilbert damping parameter $\alpha$ is reduced from $\approx 0.02$ to $\approx 0.005$, lower than $\alpha$ of permalloy. These low-damping spinel ferrite thin films facilitate the development of new spintronic devices based on insulating oxides.

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