Berry curvature induced giant anomalous and spin texture driven Hall responses in the layered kagome antiferromagnet $GdTi_3Bi_4$

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We report giant anomalous and spin texture driven Hall effects in single crystal of $GdTi_3Bi_4$, a layered kagome antiferromagnet. Detailed magnetization and magneto-transport measurements show that $GdTi_3Bi_4$ is a highly anisotropic, frustrated antiferromagnet featuring multiple magnetic phases. The ac susceptibility measurements at 3.4 Tesla show frequency-dependent shift suggesting glassy magnetic behavior. Critical slowing down model indicates large spin relaxation time 4.21×10^{-8} s and dynamic exponent 4.24, indicating formation of spin clusters or nanoscale noncollinear spin textures. Magnetoresistance shows sharp jumps resembling giant magnetoresistance multilayers, attributed to moment reorientation within adjacent antiferromagnetic layers. At 2 K, $GdTi_3Bi_4$ exhibits dual Hall responses, a giant anomalous Hall conductivity of 8652 $\Omega^{-1}\,cm^{-1}$ and a large spin texture driven Hall resistivity up to 0.12 $\mu\Omega\,cm$, together exceeding existing standards. TYJ model shows that the Hall response is dominated by colossal skew scattering and enhanced intrinsic Berry curvature contributions, likely due to strong f-electron effects. These findings establish $GdTi_3Bi_4$ as a rare platform exhibiting both giant anomalous and spin texture Hall responses, opening route for the development of materials with giant Hall effects suitable for spintronic and Hall sensing applications.