Fig. S1 (a)-(h) Transmissions of SS_{sy}@3-Ag_{2}SNR, SS_{sy}@5-Ag_{2}SNR, SS_{sy}@7-Ag_{2}SNR, SS_{sy}@9-Ag_{2}SNR, SS_{as}@4-Ag_{2}SNR, SS_{as}@6-Ag_{2}SNR, SS_{as}@8-Ag_{2}SNR and SS_{as}@10-Ag_{2}SNR, respectively. The blue dashed dot line denotes the spin up transmission, and red solid line denotes spin down one.

Fig. S2 (a)-(h) Transmissions of AgS_{as}@4-Ag_{2}SNR, AgS_{as}@6-Ag_{2}SNR, AgS_{as}@8-Ag_{2}SNR, AgS_{as}@10-Ag_{2}SNR, AgS_{sy}@3-Ag_{2}SNR, AgS_{sy}@5-Ag_{2}SNR, AgS_{sy}@7-Ag_{2}SNR and AgS_{sy}@9-Ag_{2}SNR, respectively. The blue dashed dot line denotes the spin up transmission, and red solid line denotes spin down one.
**Fig. S3** (a)-(h) Transmissions of AgAgas@3-Ag2SNR, AgAgas@5-Ag2SNR, AgAgas@7-Ag2SNR, AgAgas@9-Ag2SNR, AgAgas@4-Ag2SNR, AgAgas@6-Ag2SNR, AgAgas@8-Ag2SNR and AgAgas@10-Ag2SNR, respectively. The blue dashed dot line denotes the spin up transmission, and red solid line denotes spin down one.

**Fig. S4** (a)-(h) Band structures of SSsy@3-Ag2SNR, SSsy@5-Ag2SNR, SSsy@7-Ag2SNR, SSsy@9-Ag2SNR, SSas@4-Ag2SNR, SSas@6-Ag2SNR, SSas@8-Ag2SNR and SSas@10-Ag2SNR, respectively. The blue solid line denotes the spin up bands, and red solid line denotes spin down one.
Fig. S5 (a)-(h) Band structures of AgSas@4-Ag$_2$SNR, AgSas@6-Ag$_2$SNR, AgSas@8-Ag$_2$SNR, AgSas@10-Ag$_2$SNR, AgSsy@3-Ag$_2$SNR, AgSsy@5-Ag$_2$SNR, AgSsy@7-Ag$_2$SNR and AgSsy@9-Ag$_2$SNR, respectively. The blue solid line denotes the spin up bands, and red solid line denotes spin down one.

Fig. S6 (a)-(h) Band structures of AgAgas@3-Ag$_2$SNR, AgAgas@5-Ag$_2$SNR, AgAgas@7-Ag$_2$SNR, AgAgas@9-Ag$_2$SNR, AgAgas@4-Ag$_2$SNR, AgAgas@6-Ag$_2$SNR, AgAgas@8-Ag$_2$SNR and AgAgas@10-Ag$_2$SNR, respectively. The blue solid line denotes the spin up bands, and red solid line denotes spin down one.
Fig. S7 (a)-(f) The band structures of AgAg₅@5-Ag₂SNR under the applied tensile strains (from 2% to 12%). The blue dashed line denotes the spin up band structure, and the red solid line denotes the spin down one. The Fermi level ($E_F$) is set to 0.

Fig. S8 (a)-(f) The band structures of AgAg₅@5-Ag₂SNR under the applied compressible strains (from -2% to -12%). The blue dashed line denotes the spin up band structure, and the red solid line denotes the spin down one. The Fermi level ($E_F$) is set to 0.
Fig. S9 (a)-(f) The band structures of Ag$_{36}$S@6-Ag$_2$SNR under the applied tensile strains (from 2% to 12%). The blue dashed line denotes the spin up band structure, and the red solid line denotes the spin down one. The Fermi level ($E_F$) is set to 0.

Fig. S10 (a)-(f) The band structures of Ag$_{36}$S@6-Ag$_2$SNR under the applied compressible strains (from -2% to -12%). The blue dashed line denotes the spin up band structure, and the red solid line denotes the spin down one. The Fermi level ($E_F$) is set to 0.
**Fig. S11** (a)-(f) The band structures of SS\textsubscript{As}@6-Ag\textsubscript{2}SNR under the applied tensile strains (from 2\% to 12\%). The blue dashed line denotes the spin up band structure, and the red solid line denotes the spin down one. The Fermi level ($E_F$) is set to 0.

**Fig. S12** (a)-(f) The band structures of SS\textsubscript{As}@6-Ag\textsubscript{2}SNR under the applied compressible strains (from -2\% to -12\%). The blue dashed line denotes the spin up band structure, and the red solid line denotes the spin down one. The Fermi level ($E_F$) is set to 0.