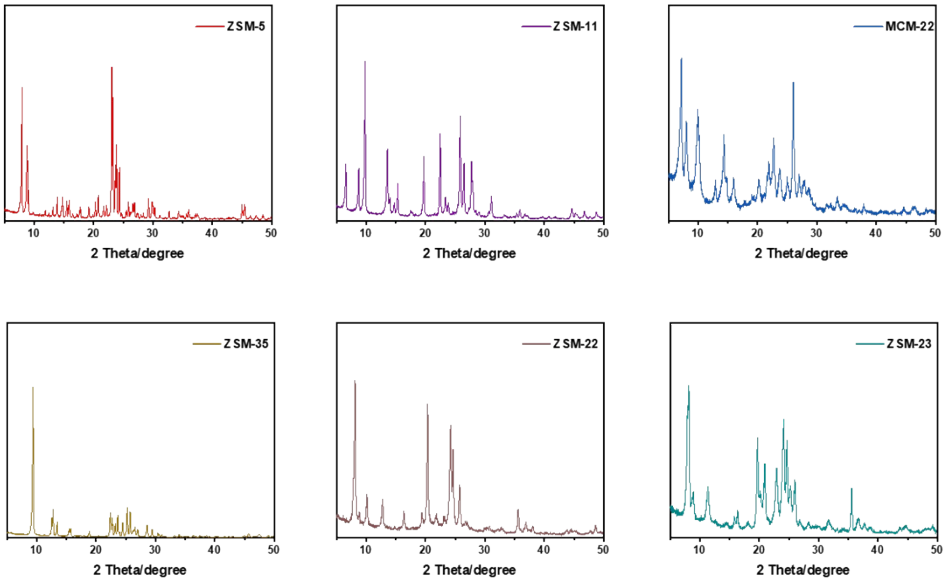


**Figure S1.** XRD of different zeolites.

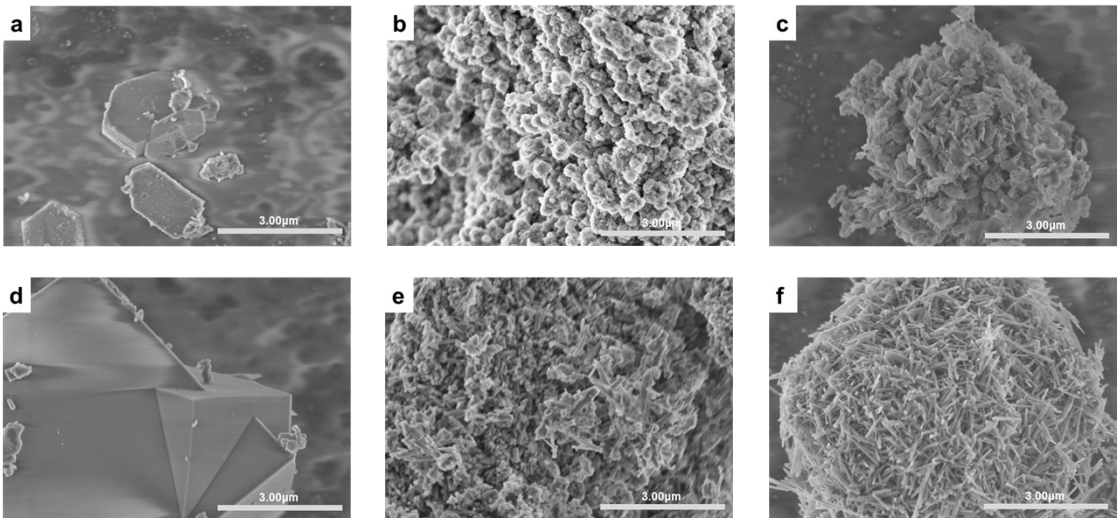


**Figure S2. SEM image of different zeolites**.
(a) ZSM-5 (b) ZSM-11 (c) MCM-22 (d) ZSM-35 (e) ZSM-22 (f) ZSM-23

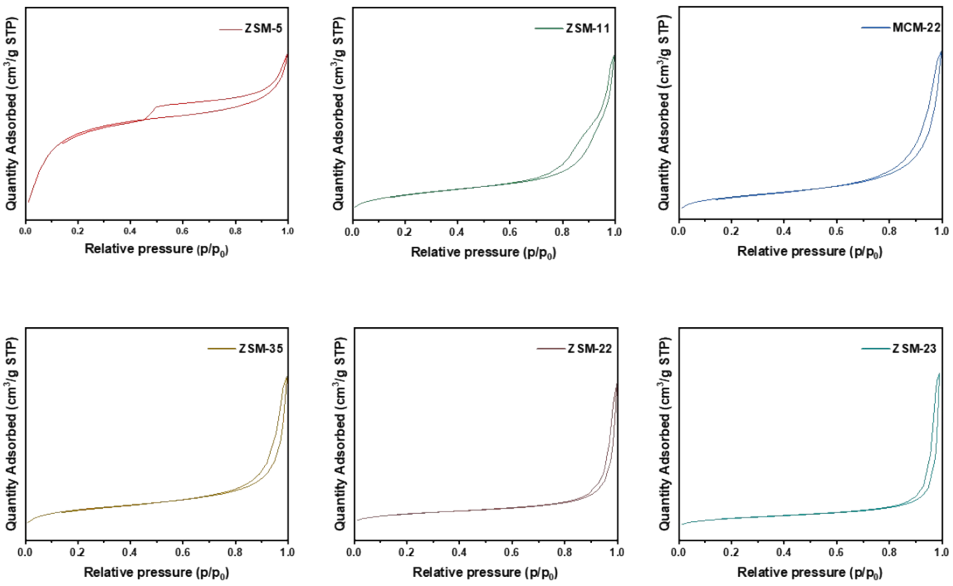


**Figure S3. The $N_2$ adsorption-desorption isotherms of different zeolites.**

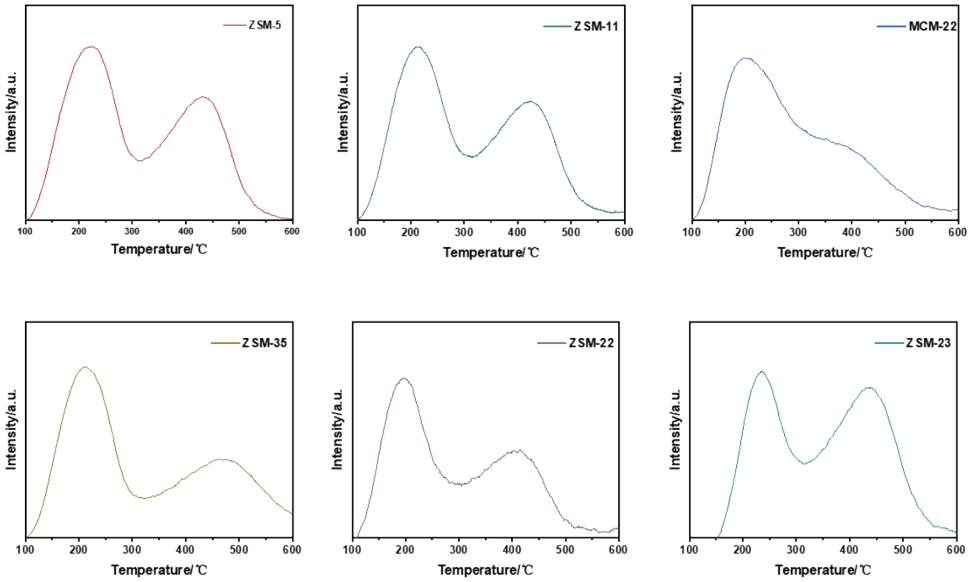


**Figure S4. $NH_3$-TPD profiles of different zeolites.**

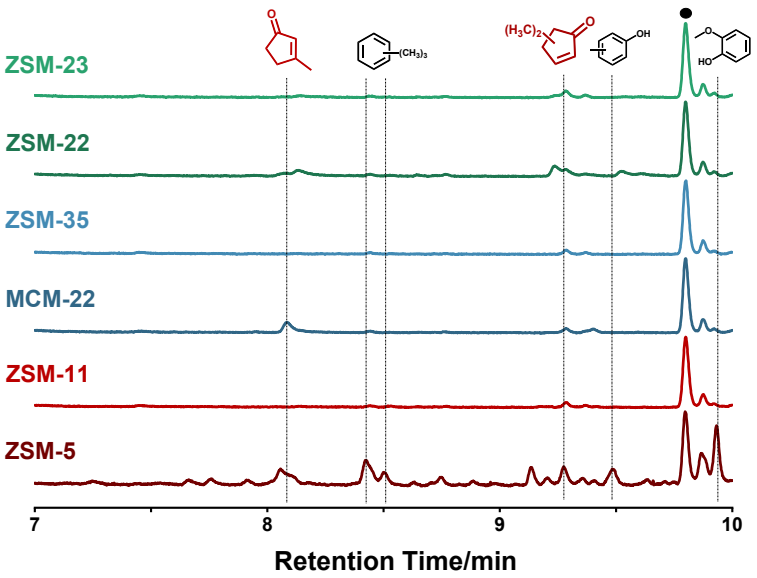


**Figure S13**. **GC-MS of organic materials retained in different spent zeolites.** Reaction conditions: 673K, P = 2 MPa, P(CO) = 1.13 MPa, $P(C_2H_5Cl)$ = 9.57 kPa, WHSV = 0.1 $g_{C2H5Cl}$ $g_{cat}^{-1}$ $h^{-1}$, Ar as balance gas.

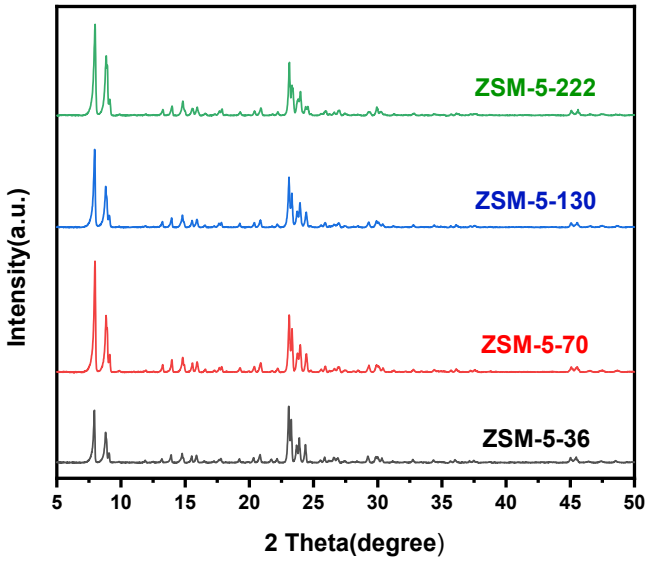


**Figure S6. XRD of H-ZSM-5 with different $SiO_2/Al_2O_3$.**

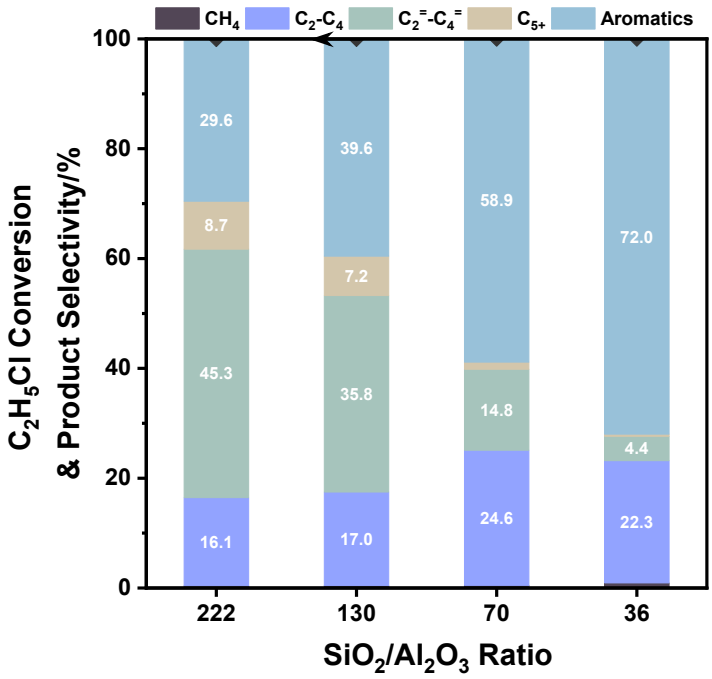


**Figure S7. Catalytic performances in $C_2H_5Cl$ coupling CO to Aromatics reaction over H-ZSM-5 with different $SiO_2/Al_2O_3$.** Reaction conditions: 673 K, P = 2 MPa, P(CO) = 1.13 MPa, $P(C_2H_5Cl)$ = 9.57 kPa, WHSV = 0.1 $g_{C2H5Cl}$ $g_{cat}^{-1}$ $h^{-1}$, Ar as balance gas.

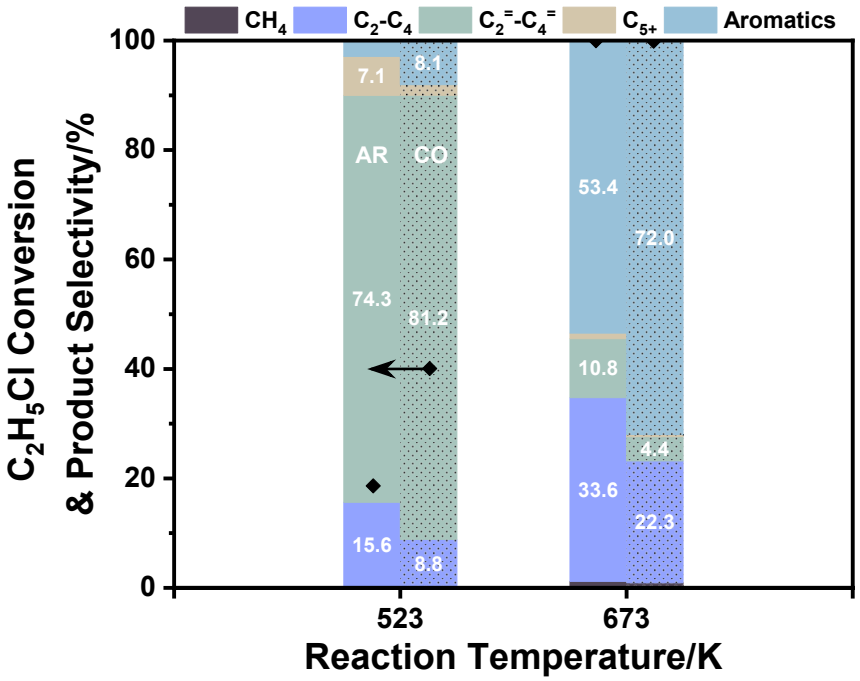


**Figure S8**. **Catalytic performance over H-ZSM5$_{36}$ with different temperature under Ar/ CO atmosphere.** Reaction conditions: 523/673 K, P = 2 MPa, P(CO) = 1.13 MPa /P(Ar) = 1.99 MPa, P($C_2H_5Cl$) = 9.57 kPa, WHSV = 0.1 $g_{C2H5Cl}$ $g_{cat}^{-1}$ $h^{-1}$, Ar as balance gas.

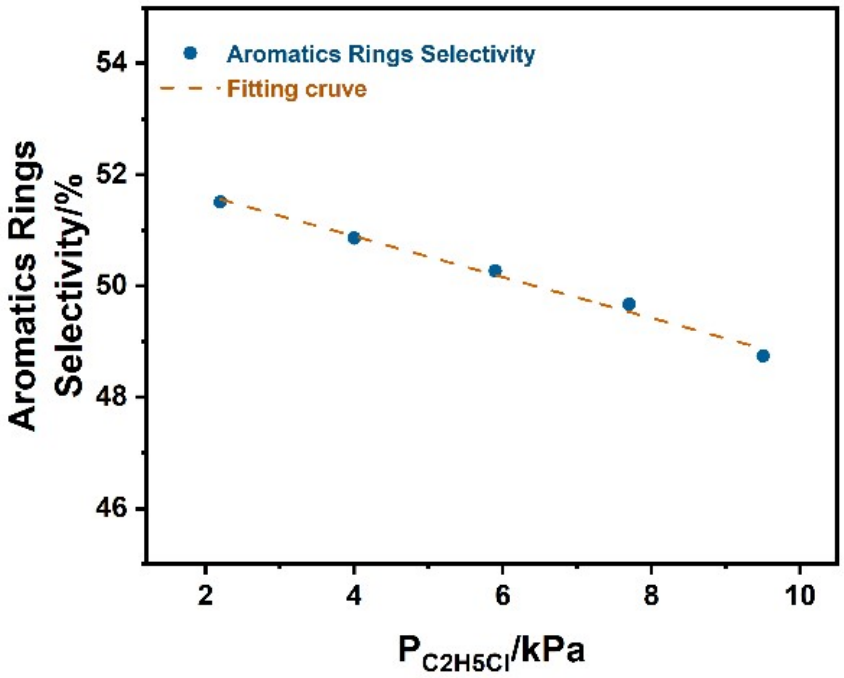


**Figure S9. The $C_2H_5Cl$ conversion, product selectivity at different $C_2H_5Cl$ partial pressures.** Reaction conditions: 673 K, P = 2.0 MPa, P(CO) = 1.13 MPa, P($C_2H_5Cl$) = 2.2 - 9.57x$10^{-3}$ MPa, WHSV = 0.1 $g_{C2H5Cl}$ $g_{cat}^{-1}$ $h^{-1}$, Ar as balance gas.

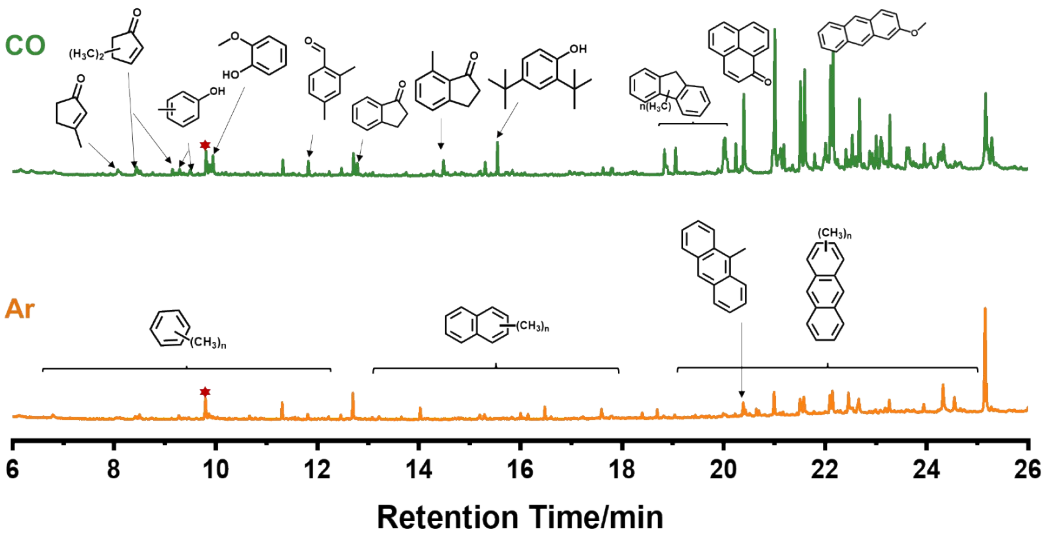


**Figure S10**. **GC-MS species retained in spent H-ZSM-5$_{36}$ under Ar or CO co-feeding.** Reaction conditions: 673K, P = 2 MPa, P(CO) = 1.13 MPa /P(Ar) = 1.99 MPa, P($C_2H_5Cl$) = 9.57 kPa, WHSV = 0.1 $g_{C2H5Cl}$ $g_{cat}^{-1}$ $h^{-1}$, Ar as balance gas.

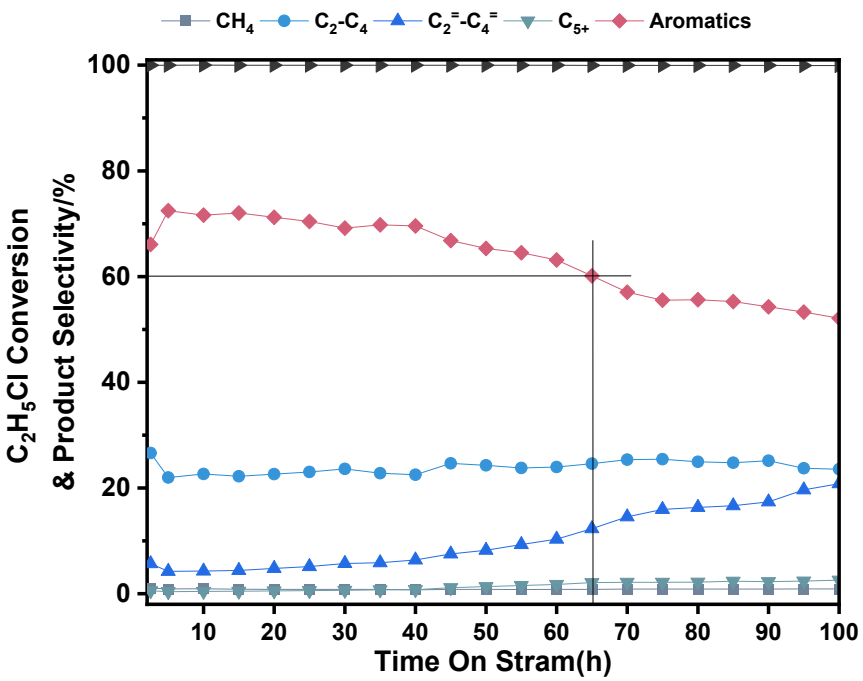


**Figure S11. Catalytic performance over HZSM-5$_{36}$.**Reaction conditions: 673K, P = 2 MPa, P(CO) = 1.13 MPa, P($C_2H_5Cl$) = 9.57x$10^{-3}$ MPa, WHSV = 0.1 g $gcat^{-1}$ $h^{-1}$. Ar as balance gas.

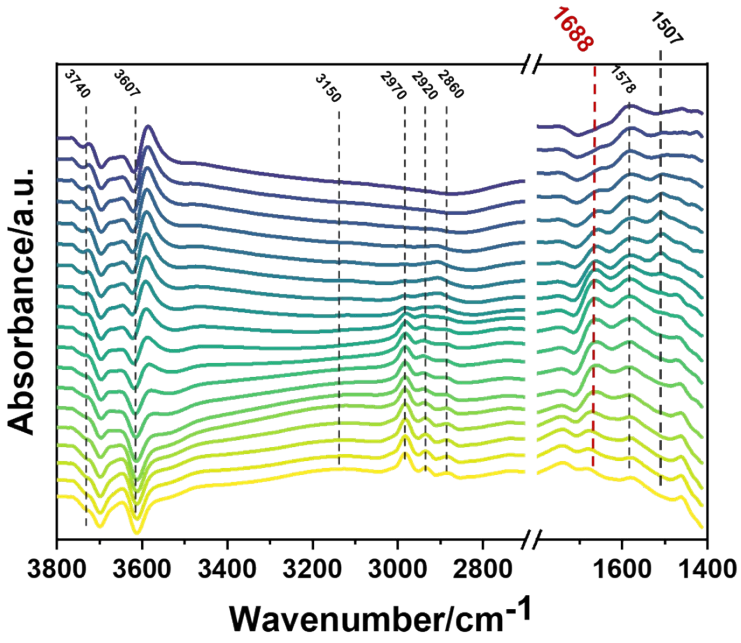


**Figure S12. Temperature-programmed in situ DRIFT characterization of $C_2H_4$+CO as feedstock over H-ZSM-$5_{36}$ under different atmospheres.** Reaction conditions: CO/$C_2H_4$=6.8, 323 – 673 K, P = 0.1 MPa, Ar as balance gas.

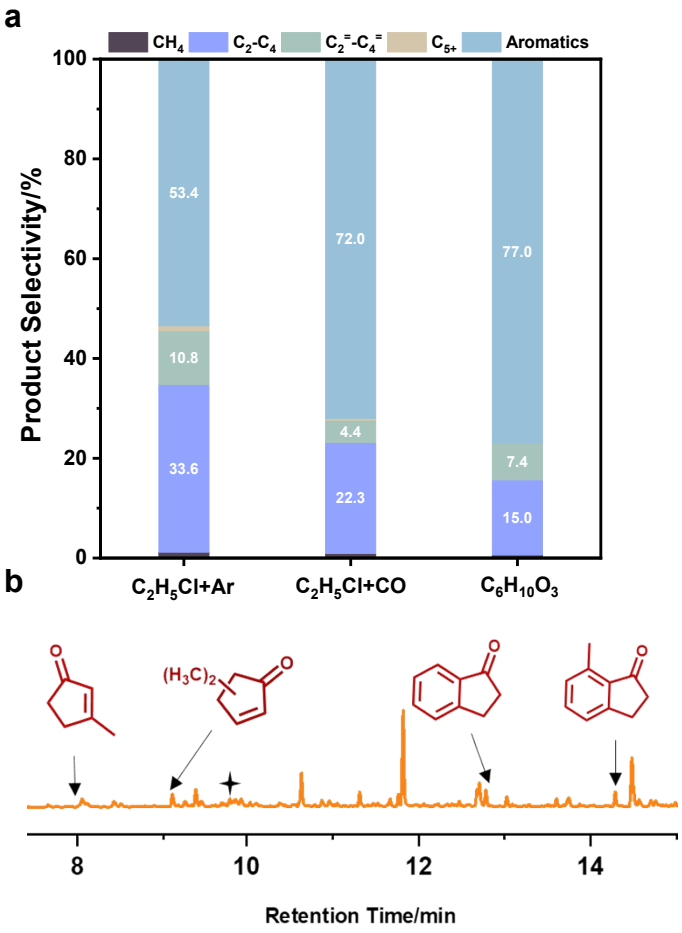


**Figure S13. Catalytic performance of maleic anhydride feed over HZSM-5$_{36}$.a) Product distribution. b) GC-MS of organic materials retained in spent H-ZSM-5$_{36}$.** Reaction conditions: 673K, P = 2 MPa, P($C_6H_{10}O_3$) = 9.57 kPa, WHSV = 0.1 $g_{C2H5Cl\ or\ C6H10O3}$ $g_{cat}^{-1}$ $h^{-1}$. Ar as balance gas.

**Table S1.** Framework information and textural properties of zeolites with different topology obtained from the $N_2$ adsorption and desorption isotherms

| Topology | Type material | Channel dimensionality | $SiO_2/Al_2O_3$ mole ratio [a] | Surface area[b] ($m^2/g$) | Pore volume[c] ($cm^3/g$) | Strength acid concentration[d] (mmol/g STD) | Weak acid concentration[d] (mmol/g STD) |
|---|---|---|---|---|---|---|---|
| MFI | ZSM-5 | 3-dimensional | 36 | 322.7 | 0.17 | 0.49 | 0.60 |
| MEL | ZSM-11 | 3-dimensional | 36 | 306.1 | 0.30 | 0.34 | 0.43 |
| MWW | MCM-22 | 2-dimensional | 39 | 362.6 | 0.37 | 0.07 | 0.82 |
| FER | ZSM-35 | 2-dimensional | 29 | 326.5 | 0.26 | 0.32 | 0.52 |
| TON | ZSM-22 | 1-dimensional | 38 | 109.0 | 0.11 | 0.13 | 0.21 |
| MTT | ZSM-23 | 1-dimensional | 34 | 218.4 | 0.27 | 0.24 | 0.12 |

**a: measured by XRF; b: BET surface; c: Single-point pore volume at $P/P_0=0.975$; d: measured by $NH_3$-TPD**

**Table S2.** The estimated aromatic ring selectivity obtained when $C_2H_5Cl$ or $C_2H_4$ was co-fed with CO.

| Aromatic rings selectivity/% / Feedstock | $C_6H_6$ | $A_7$ | $A_8$ | $A_9$ | $A_{10}$ | $A_{10+}$ | total |
|---|---|---|---|---|---|---|---|
| **$C_2H_5Cl$** | 8.47 | 18.04 | 11.12 | 1.64 | 0.25 | 28.15 | 47.59 |
| **$C_2H_4$** | 5.33 | 15.11 | 13.39 | 2.22 | 0.47 | 35.95 | 48.05 |

Reaction conditions: 673 K, P = 2 MPa, P(CO) = 1130 kPa, P($C_2H_5Cl$) = 9.57 kPa, WHSV = 0.1 $g_{C2H5Cl}$ $g_{cat}^{-1}$ $h^{-1}$. Ar as balance gas.