CML103 - Major (Part-1)

Name: Shubham Garampalli

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Q2.

Shubham Garampalli
ES20CH70196

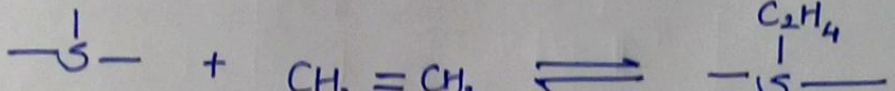
$$V = \frac{K[H_2][C_2H_4]}{(1 + K[C_2H_4])}$$

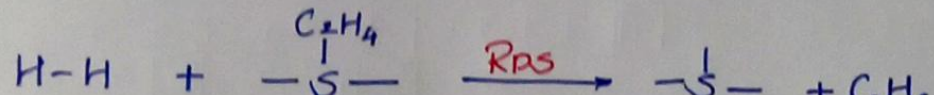
→ Mechanism of Addition of Hydrogen on Ethylene on Nickel surface

The Given Rate eqn suggest 3 possibilities ;

1. Rate = $K\theta_A\theta_B$ (1) ; Rate = $K\theta_A[B]$ (2) ; Rate = $K\theta_B[A]$ (3)

∴ As in the question H_2 is gas free Hence (2) Eqn





∴ Now proceeding to calculate θ_A

C_2H_4 +	$-S-$	⇌	$-S(C_2H_4)-$
A_0	1		0
A_0	$1-\theta_A$		θ_A

$$\frac{K_1}{K_{-1}} = \frac{\theta_A}{[C_2H_4][1-\theta_A]}$$

$$\frac{K_1}{K_{-1}} = K = \frac{\theta_A}{[1-\theta_A][C_2H_4]}$$

$$\theta_A = K[1-\theta_A][C_2H_4]$$

$$\theta_A = \frac{K[C_2H_4]}{1 + K[C_2H_4]}$$

∴ Rate of Rxn: $= K\theta_A[B] = \frac{(K \times K)[C_2H_4]}{1 + K[C_2H_4]} \times [H_2]$ ($K \times K = K_0$)

$$= \frac{K_0[H_2][C_2H_4]}{1 + K[C_2H_4]}$$

∴ → Proved the mechanism.

Q3.

$$E + A \underset{K_{-1}}{\overset{K_1}{\rightleftharpoons}} EA$$

$$EA + B \underset{K_{-2}}{\overset{K_2}{\rightleftharpoons}} EAB \xrightarrow{K_3} E + Y + Z$$

$$[E_0] = [E] + [EA] + [EAB]$$

$$\frac{[E_0]}{[EAB]} = \frac{[E] + [EA] + [EAB]}{[EAB]} \quad \text{---(1)}$$

$$\frac{K_1}{K_{-1}} = \frac{[EA]}{[E][A]} \quad \text{---(2)}$$

$$\frac{K_2}{K_{-2}} = \frac{[EAB]}{[EA][B]} \quad \text{---(3)}$$

$$\therefore \quad \frac{K_{-2}}{K_2[B]} = \frac{[EA]}{[EAB]} \quad \text{---(4)} \cdot \frac{[E]}{[EAB]} =$$

$\therefore$ from (1) :-

$$\frac{[E_0]}{[EAB]} = \frac{[E]}{[EAB]} + \frac{[EA]}{[EAB]} + 1$$

$$= \frac{[E]}{[EAB]} + \frac{K_{-2}}{K_2[B]} + 1 \quad \cdots \text{ from (4)} \quad \text{---(*)}$$

$\therefore$ from (2) & (3):-

$$\therefore \quad [E] = \frac{K_{-1}[EA]}{K_1[A]} \quad ; \quad [EA] = \frac{K_{-2}}{K_2} \times \frac{[EAB]}{[B]}$$

$$\therefore \quad [E] = \frac{K_{-1}}{K_1} \times \frac{K_{-2}}{K_2} \times \frac{[EAB]}{[A][B]} \quad \text{---(5)}$$

$\therefore$ Putting (5) in (*) :-

$$\frac{[E_0]}{[EAB]} = \frac{K_{-1}K_{-2}}{K_1K_2} \frac{[EAB]}{[A][B][EAB]} + \frac{K_{-2}}{K_2[B]} \times K_1[A] + \frac{1}{1} \times K_1K_2[A][B]$$

$$\times K_1 \times [A] \qquad K_1K_2[A][B]$$