

Supplement 4: Assignment of IR and Raman bands of the manganese phosphate coatings deposited on mild steel

IR bands (cm^{-1})	Assignment	Raman bands (cm^{-1})	Assignment
3428	$\nu(\text{O-H})$ of H_2O (stretching)	1075	$\nu_3\text{HPO}_4^{2-}$ and PO_4^{3-} (antisymmetric stretching)
3306	$\nu(\text{O-H})$ of H_2O (stretching)	1041	$\nu_3\text{HPO}_4^{2-}$ and PO_4^{3-} (antisymmetric stretching)
3178	$\nu(\text{O-H})$ of H_2O (stretching)	1025	$\nu_3\text{HPO}_4^{2-}$ and PO_4^{3-} (antisymmetric stretching)
2925	$\nu(\text{O-H})$ of H_2PO_4^- (stretching)	1005	$\nu_3\text{HPO}_4^{2-}$ and PO_4^{3-} (antisymmetric stretching)
2854	$\nu(\text{O-H})$ of H_2PO_4^- (stretching)	993	$\nu_1(\text{PO}_4^{3-})$ (stretching)
2504	$\nu(\text{O-H})$ of H_2PO_4^- (stretching)	945	$\nu_1(\text{P-O})$ of (HPO_4^{2-}) (stretching)
1721	$\delta(\text{H-O-H})$ of H_2O (bending)	598	$\nu_4 \text{HPO}_4^{2-}$ and PO_4^{3-} (out of plane bending)
1639	$\delta(\text{H-O-H})$ of H_2O (bending)	582	$\nu_4 \text{HPO}_4^{2-}$ and PO_4^{3-} (out of plane bending)
1378	P=O Stretching	543	$\nu_4 \text{HPO}_4^{2-}$ and PO_4^{3-} (out of plane bending)
1307	$\delta(\text{P-O-H})$ of $(\text{HPO}_4)^{2-}$ (bending)	532	$\nu_4 \text{HPO}_4^{2-}$ and PO_4^{3-} (out of plane bending)
1151	$\nu_3\text{HPO}_4^{2-}$ and PO_4^{3-} (antisymmetric stretching)	455	$\nu_2 \text{HPO}_4^{2-}$ and PO_4^{3-} (bending)
1077	$\nu_3\text{HPO}_4^{2-}$ and PO_4^{3-} (antisymmetric stretching)	412	$\nu_2 \text{HPO}_4^{2-}$ and PO_4^{3-} (bending)
1048	$\nu_3\text{HPO}_4^{2-}$ and PO_4^{3-} (antisymmetric stretching)	303	$\delta(\text{M-O})$ (bending)
1028	$\nu_3\text{HPO}_4^{2-}$ and PO_4^{3-} (antisymmetric stretching)		
983	$\nu_s(\text{PO}_4)^{3-}$ (symmetric stretching)		
983	$\nu(\text{Mn=O})$ and $\nu(\text{Mn-O-Mn})$ (stretching)		
939	$\nu(\text{P-O})$ of HPO_4^{2-} (stretching)		
752	$\nu_s(\text{P-O})$ of $(\text{PO}_4)^{3-}$ (symmetric stretching)		
711	$\nu_s(\text{P-O})$ of $(\text{PO}_4)^{3-}$ (symmetric stretching)		
711	$\nu(\text{Mn=O})$ and $\nu(\text{Mn-O-Mn})$ (stretching)		