vibration region at 700–800 cm^{-1} from the uncomplexed ligand, indicating that no bonding occurred to the sulfur atom [27].

Tables 1 and 2 tabulate the low-frequency absorptions for 2,2′-DTDP, $^{NA}ZnCl_2$·(2,2′-DTDP), $^{NA}ZnBr_2$·(2,2′-DTDP), and for the zinc complexes containing the zinc isotopes of mass 64 and 68. Figure 1 depicts the spectra of isotopic zinc halide complexes from 325–100 cm^{-1}.

Table 1. Observed frequencies (cm^{-1}), isotopic shifts, and band assignments for $ZnCl_2$ · (2,2′-DTDP)

2,2′-DTDP	$^{NA}ZnCl_2$·(2,2′-DTDP)	$^{64}ZnCl_2$·(2,2′-DTDP)	$^{68}ZnCl_2$·(2,2′-DTDP)	$\tilde{\nu}(^{64}Zn) - \tilde{\nu}(^{68}Zn)$	Assignments
	648(m, sp)	648	648	0	
	648(m, sp)	641	641	0	
622(s, p)					
	499(m, sp)	500	501	−1	Ligand and ligand induced
	487(m, sp)	488	487	1	
471(m, sp)					
429(m, sp)	429(m, sp)	429	429	0	
	417(s, sp)	417	417	0	
402(sh)					
345(s, sp)	345(w)				
	321(vs)	322	321	1	νZn—Cl_{asym} + ligand
	293(vs)	294	291	3	νZn—Cl_{sym}
254(vvw)					
	242(m)	242	242	0	Ligand
	231(m)	231	231	0	
	222(m)	224	220	4	νZn—N
158(w)	158(m)	—	—	—	Ligand, δZn—Cl and lattice vibrations
	130(s), 121(sh)	130	129	1	
	108(m)	108	108	0	

Abbreviations: s = strong; sp = sharp; m = medium; w = weak; v = very; sh = shoulder.

Table 2. Observed frequencies (cm^{-1}), isotopic shifts, and band assignments for $ZnBr_2$ · (2,2′-DTDP)

2,2′-DTDP	$^{NA}ZnBr_2$·(2,2′-DTDP)*	$^{64}ZnBr_2$·(2,2′-DTDP)	$^{68}ZnBr_2$·(2,2′-DTDP)	$\tilde{\nu}(^{64}Zn) - \tilde{\nu}(^{68}Zn)$	Assignments
	646(m, sp)	646	646	0	
	639(m, sp)				
622(s, sp)					
	499(m, sp)	501	500	1	
	486(m, sp)	488	488	0	Ligand and ligand induced
471(m, sp)					
429(m, sp)	429(m, sp)	429	429	0	
	417(s, sp)	418	417	1	
402(sh), 345(s, sp)					
	320(m)	320	320	0	
254(vvw)					
	247(vs)	248	244	4	$\nu$$ZnBr_{asym}$
	223(s)	226	221	5	νZn—N
	200(s)	201	197	4	νZn—Br_{sym}
158(w)	152(vw)	—	—	—	
	133(vw), 120(vw)	133	133	0	Ligand and lattice vibrations
	113(vw)	—	—	—	
	98(m)	100	99	1	

Abbreviations: s = strong; sp = sharp; m = medium; w = weak; v = very; sh = shoulder.

* The observed i.r. frequencies for the $^{NA}ZnI_2$(2,2′-DTDP) complex from 650–80 cm^{-1} are 648(m), 528(vvw), 487(s, sp), 438(w), 433(w), 421(s, sp), 417(s, sp), 348(w), 314(s), 240(m), 231(m), 213(m), 194(s), 185(s), 162(m), 140(vw), 115(vvw), 100(vvw), 84(m). No band assignments were made for this compound since no isotopic studies were conducted for it.

[27] P. C. H. MITCHELL and R. J. P. WILLIAMS, *J. Chem. Soc.* 1912 (1960).