

2.5. ELECTRON DIFFRACTION AND ELECTRON MICROSCOPY IN STRUCTURE DETERMINATION

Table 2.5.3.6. Symmetries of square four-beam CBED patterns for diffraction groups

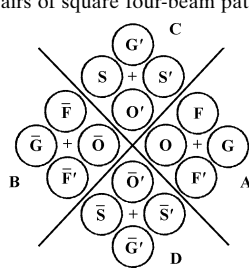
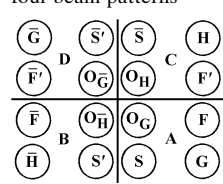
		Projection diffraction group								
		41_R			$4mm1_R$					
Diffraction group		4	4_R	41_R	$4m_Rm_R$	$4mm$	4_Rmm_R	$4mm1_R$		
Two-dimensional symmetry		4	(2)	4	4	$4mm$	($2mm$)	$4mm$		
Three-dimensional symmetry			$\bar{4}$	$m', (i, \bar{4})$	$2'$		$\bar{4}, 2'$	$m', (i, 2', \bar{4})$		
Zone-axis pattern	Bright-field pattern	4	4	4	$4mm$	$4mm$	$4mm$	$4mm$		
	Whole-field pattern	4	2	4	4	$4mm$	$2mm$	$4mm$		
Square four-beam pattern	O	1	1	1	m_2	m_v	m_2	m_v	$m_v(m_2)$	
	G	1	1	1_R	m_2	m_v	m_2	m_v	$1_Rm_v(m_2)$	
	F	1	1	1	m_2	1	1	m_2	m_2	
	FF'	1	4_R	4_R	1	m_v	4_R	4_Rm_v	4_Rm_v	
Two pairs of square four-beam patterns 	AB	$\pm O$	2	2	$2(1_R)$	$2m_2$	$2m_v$	$2m_2$	$2m_v$	$2(1_R)m_v(m_2)$
		$\pm G$	2	2	21_R	$2m_R$	$2m_v$	$2m_R$	$2m_v$	$21_Rm_v(m_R)$
		FF'	2	2	2	$2m_R$	2	2	$2m_R$	$2m_R$
		$\pm F$	1	4_R	4_R	1	m_v	4_R	4_Rm_v	4_Rm_v
	AC	OO'	4	4	4	$4m_2$	$4m_v$	$4m_v$	$4m_2$	$4m_v(m_2)$
		GG'	4	4_R	41_R	$4m_R$	$4m_v$	4_Rm_v	4_Rm_R	$41_Rm_v(m_R)$
		FS	4	1	4	$4m_R$	4	m_R	1	$41_Rm_v(m_R)$
		FS'	1	1	1_R	1	m_v	m_v	1	1_Rm_v
		Point group		4	$\bar{4}$	$4/m$	432, 422	$4mm$	$\bar{4}3m, \bar{4}2m$	$m\bar{3}m, 4/mmm$

Table 2.5.3.7. Symmetries of rectangular four-beam CBED patterns for diffraction groups

		Projection diffraction group							
		$m1_R$			$2mm1_R$				
Diffraction group		m_R	m	$m1_R$	$2m_Rm_R$	$2mm$	2_Rmm_R	$2mm1_R$	
Two-dimensional symmetry			m	m	2	$2mm$	m	$2mm$	
Three-dimensional symmetry		$2'$		$m', 2'$	$2'$		$2', i$	$m', 2', i$	
Zone-axis pattern	Bright-field pattern	m	m	$2mm$	$2mm$	$2mm$	m	$2mm$	
	Whole-field pattern	1	m	m	2	$2mm$	m	$2mm$	
Rectangular four-beam pattern	O	1	1	1	1	1	1	1	
	G	1	1	1_R	1	1	1	1_R	
	F	m_2	1	m_2	m_2	1	m_2	m_2	
	S	1	1	1	m_2	1	1	m_2	
Three pairs of rectangular four-beam patterns 	AB	O_GO_H	m_2	1	m_2	m_2	m_v	$m_v(m_2)$	$m_v(m_2)$
		$G\bar{H}$	1	1	m_R	m_v	m_v	m_v	m_vm_R
		$F\bar{F}$	1	1	1	1	m_v	2_Rm_v	2_Rm_v
		$S\bar{S}'$	1	1	1_R	1	m_v	m_v	m_v1_R
	AC	O_GO_H	1	m_v	m_v	m_2	m_v	1	$m_v(m_2)$
		GH	m_R	m_v	m_vm_R	m_R	m_v	m_R	m_vm_R
		FF'	1	m_v	m_v1_R	1	m_v	1	m_v1_R
		$S\bar{S}$	1	m_v	m_v	1	m_v	2_R	2_Rm_v
	AD	O_GO_G	1	1	1_R	2	2	1	$2(1_R)$
		GG	1	1	1	2	2	2_R	21_R
		$F\bar{F}'$	1	1	1	$2m_R$	2	1	$2m_R$
		$S\bar{S}'$	m_R	1	m_R	$2m_R$	2	m_R	$2m_R$
Point group		2, 222, $mm2$, 4, 4, 422, $4mm$, $42m$, 32, 6, 622, $6mm$, $\bar{6}m2$, 23, 432, $\bar{4}3m$	$m, mm2, 4mm, 42m, 3m, \bar{6}, 6mm, 6m2, 43m$	$mm2, 4mm, 42m, 6mm, \bar{6}m2, 43m$	222, 422, $42m, 622, 23, 432$	$mm2, \bar{6}m2$	$2/m, mmm, 4/m, 4/mmm, 3m, \bar{6}/m, 6/mmm, m3, m3m$	$mmm, 4/mmm, m3, m3m, 6/mmm$	

The ordinary extinction rules for screw axes and glide planes hold only in the approximation of kinematical diffraction. The kinematically forbidden reflections caused by these symmetry elements appear owing to *Umweganregung* of dynamical diffraction. Extinction of intensity, however, does take place in these reflections at certain crystal orientations with respect to the

incident beam (*i.e.* in certain regions within a CBED disc). This dynamical extinction was first predicted by Cowley & Moodie (1959) and was discussed by Miyake *et al.* (1960) and Cowley *et al.* (1961). Goodman & Lehmpfuhl (1964) first observed the dynamical extinction as dark cross lines in kinematically forbidden reflection discs of CBED patterns of CdS. Gjønnes & Moodie