Contents

1 Introduction 10
   1.1 Crystal plasticity 10
   1.2 Dislocations 10
   1.3 Energy considerations 12
   1.4 Content of the thesis 15

2 The minimal Dirichlet energy for the jump problem 18
   2.1 The space $H^{1/2}({\mathbb{R}^{n-1}})$ 18
   2.2 The Dirichlet energy in terms of parallel jumps 21

3 The minimal linear elastic energy for the jump problem 23
   3.1 Interaction between parallel planes 33
   3.2 Positivity of the kernel and iterative mollification 36
   3.3 Fourier methods 40

4 The phase-field energy and compactness 43
   4.1 Preliminaries 43
   4.2 Compactness results 47

5 The limit energy and upper bound 55
   5.1 The upper bound 58
   5.2 Some properties of the double relaxation 62

6 Extension of BV functions in a perforated domain 64
   6.1 The boundaries of bounded convex sets in the plane 64
   6.2 A ball construction using increasing convex sets 66

7 Slip fields with parallel straight dislocation lines 69
   7.1 Energy estimates for positive kernels 70
   7.2 Energy estimates for step functions 73
   7.3 Approximation by step functions 77

8 The lower bound 77