The first and second layers can be in positions labelled A and B while the third layer can be placed above the C positions. The pattern continues as ABCABC..., the pattern repeating at every third layer.

A stacking fault* in such an fcc structure occurs if this sequence gets disturbed, as in ABCBCABC.... Here a layer A is missing, while in the sequence ABCABACABC... an extra A layer has been introduced. While stacking faults can, at least in principle, extend through the entire crystal, they usually occupy only a part of the plane. In this last case, of a stacking fault which terminates within the crystal, the configuration at the termination is referred to as a partial dislocation.

1.6. *Glissile and Sessile Dislocations*

Dislocations that can move by pure slip are called glissile. Dislocations which cannot glide, but have to move by some form of mass transport are called sessile (Read, 1953).

In crystals, the dislocation core spreads to certain crystallographic planes containing the dislocation line. If the core spreads into one of such planes, the core is planar and is glissile. If the core spreads into several non-parallel planes of the zone of the dislocation line, it is non-planar and is sessile. In the former case the dislocation moves easily in the plane of the core spreading, while in the latter case, it moves only with difficulty (Vitek, 1992). A Shockley partial is a partial dislocation, the Burgers vector of which lies in the plane of the fault. Then, Shockley partials are glissile. A Frank partial is a partial dislocation, the Burgers vector of which is not parallel to the fault. Then, Frank partials are sessile.

1.7. *Concept of Fractals*

Over a decade or more, diverse scientists have recognized that many of the structures common in their experiments have a quite special kind of geometrical complexity. The pioneering work was that of Mandelbrot (1977, 1979, 1982, 1988) who drew attention to the particular geometrical properties of such things as the shore of continents, tree branches, or the surface of clouds.

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*Stacking faults remain a challenge for interatomic force fields. A novel system which might test N-body force lows discussed in Chapter 8 has arisen from the study of S. A. de Vries *et al.*, (Phys. Rev. Lett. *81*, 381, 1998). These authors have studied the influence of Sb on the formation of stacking faults due to Ag(111) growth using X-ray scattering (see also related theoretical studies of S. Oppo *et al.*, Phys. Rev. Lett. *71*, 2437, 1993).

Mandelbrot used the word 'fractal' for these complex shapes, in order to emphasize that they are to be characterized by a non-integer (fractal) dimensionality.

Our interest here is the fractal aspects of fractured surfaces. Mandelbrot *et al.* (1984) gave an elegant route for determining the fractal dimension D of the fractured surface. Their work pointed to a correlation between toughness and D. Further studies were performed by Lung (1986), Pande (1987), Lung and Mu (1988) and Xie and Chen (1988). Bouchaud *et al.* (1990) later reported their findings that for a variety of rupture modes and materials the observed fractal dimensions were the same to within the error bars. Dauskardt *et al.* (1990) reported a fractal dimension $D \cong 2.2$, which, when combined with the studies of Bouchaud *et al.* (1990) may turn out to be a universal value (but also see below).

Though it is known that cracks in nature can have fractal character, at the time of writing it is still difficult to specify just how this fractal nature arises. For it is certainly true that the mechanisms leading to fracture are highly material dependent (see Liebowitz, 1984). This, we will discuss further in Sec. 4.17.

Progress has resulted from modelling the growth of a single, connected crack. With the assumption of central forces numerical simulations of media with a breaking probability proportional to the elongation of springs revealed that the cracks resulting are fractal (Louis *et al.*, 1986; Hinrichen *et al.*, 1989). The fractal dimension of such cracks appears to be sensitive to the type of external force (e.g. uniaxial tension, shear, uniform dilatation) but since only rather small cracks can be grown, more precision is lacking. Herrmann (1989) has considered therefore deterministic models.

1.8. *'Glue' and Related Models of Interatomic Force Fields*

Ab initio simulation of complex processes is fairly commonplace at the time of writing. But it is still eminently worth while (compare Heine, 1994) to ask whether empirical models for accounting for interatomic bonding can be refined so as to make them, even if not completely satisfactory, at least widely useful.

In the field of interest of our book, namely metals and metallic alloys, the various types of 'glue' models (Finnis and Sinclair, effective medium, embedded atom, etc.) developed since the early 1980s embody metallic many-atom bondings and therefore are major advances over earlier models.