backbone bonds ($C^* = \rho/M_o q$) and an increase in the width of the unstrained damage zone with isotropic swelling to a volumetric swelling degree of q giving:

$$d^* = z^{1/2} n^{1/2} b \left(\frac{q}{q_o}\right)^{1/3} \tag{41}$$

q_o is the swelling ratio at which the network is synthesised and where the network strands are assumed to be in their relaxed, random coil conformations. q is the swelling ratio at which the fracture energies is measured, and may or may not be the equilibrium swelling degree (i.e., $q \leq Q_{eq,o}$). The predicted fracture energy of a solvent-swollen elastomer is then:

$$G_c = \left(\frac{3}{8}\right)^{1/2} \frac{\rho}{M_o} \left(\frac{1}{q}\right)^{2/3} \left(\frac{1}{q_o}\right)^{1/3} z^{1/2} b U n^{1/2} \tag{42}$$

As illustrated in Fig. 7, the calculated fracture toughness for elastomers (dry and swollen) agrees closely with measured values. The figure contains data for various elastomers prepared with different crosslink densities and the required network parameters for calculating the toughness are given in Table 2. In most cases the measured values agree very closely with their predicted toughness. The measured toughness of *cis*-polyisoprene was almost 2–3 times larger than the predicted values. Since the calculated values were based on several assumptions, this level of agreement is considered excellent by previous researchers (Lake and Thomas 1967; Baumberger et al. 2006). The figure also contains two data sets from single network hydrogels. The gel toughness for polyacrylamide gels reported by Tanaka (Tanaka et al. 2000) and those by Zhang (Zhang et al. 2005) also agree within a similar accuracy with the predicted values.

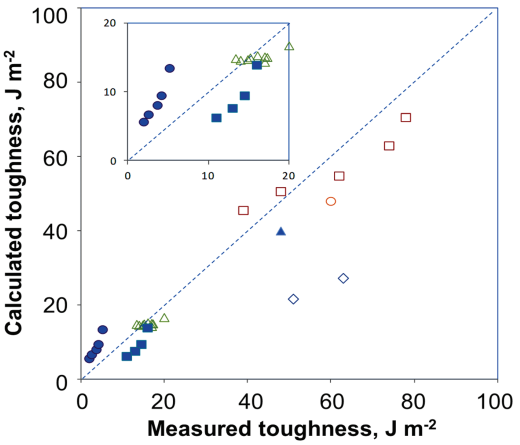

Fig. 7. Measured fracture toughness and calculated toughness values (Lake Thomas theory) for dry and swollen networks taken from literature sources: *cis*-polyisoprene [unfilled diamonds], poly(dimethyl siloxane) [unfilled squares], solvent swollen poly(dimethyl siloxane) [unfilled triangles] (Gent and Tobias 1982); polyacrylamide hydrogels [filled circles (Zhang et al. 2005) and filled squares (Tanaka et al. 2000)]; styrene-butadiene rubber [unfilled circles] neoprene rubber [filled triangles] (Bhowmick 1988). The dashed line indicates exact agreement between calculated and measured values.