### LIST OF FIGURES

<table>
<thead>
<tr>
<th>S.No</th>
<th>Figure Caption</th>
<th>Page Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Figure 1.1 Indian nuclear energy programme: The three stage</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>Figure 1.2 The backend comprises of reprocessing and waste management</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>Figure 1.3 The classification of physical process</td>
<td>22</td>
</tr>
<tr>
<td>4.</td>
<td>Figure 1.4 General scheme of FWT algorithm</td>
<td>50</td>
</tr>
<tr>
<td>5.</td>
<td>Figure 1.5 Daubechies wavelets</td>
<td>51</td>
</tr>
<tr>
<td>6.</td>
<td>Figure 2.1 Photos of mounted Specimen for polarization studies</td>
<td>28</td>
</tr>
<tr>
<td>7.</td>
<td>Figure 2.2 Photos of teflon mounted three electrode probe for EN studies in nitric acid and simulated high level waste</td>
<td>69</td>
</tr>
<tr>
<td>8.</td>
<td>Figure 2.3 Photos of bare electrodes for EN studies in chloride medium</td>
<td>70</td>
</tr>
<tr>
<td>9.</td>
<td>Figure 2.4 Potentiodynamic anodic polarization curve in nitric acid medium depicting various conditions in reprocessing plant</td>
<td>72</td>
</tr>
<tr>
<td>10.</td>
<td>Figure 2.5 Schematic representation of polarization cell (ASTM G5)</td>
<td>73</td>
</tr>
<tr>
<td>11.</td>
<td>Figure 2.6 Schematic representation of the EN cell using three identical electrode configuration</td>
<td>77</td>
</tr>
<tr>
<td>12.</td>
<td>Figure 2.7 Schematic of the connections between EN cell and instrument , WE-1: working electrode 1, WE-2 : working electrode 2</td>
<td>78</td>
</tr>
</tbody>
</table>
13. Figure 2.8 Photograph of the experimental set up for the
electrochemical studies 79
14. Figure 2.9 Typical plots of potential noise before and after trend
removal 80
15. Figure 2.10 A scheme of the data analysis methods used for the
various electrochemical noise studies 82
16. Figure 3.1 Electrochemical current and potential noise-time records
taken after a) 1 h b) 10 h c) 14 h d) 23 h e) 25 h of
immersion 89
17. Figure 3.2 PSD of potential and current noise with time of immersion
a & c) 1 h, b & d) 25 h 91
18. Figure 3.3 Optical micrograph of 304L SS after electrochemical noise
experiment showing pitting attack (after 25 h of immersion) 92
19. Figure 3.4 Standard deviation of potential noise as a function of time
of immersion, for 304L SS in 0.05 M FeCl$_3$ 94
20. Figure 3.5 Localization index for 304L SS in 0.05 M FeCl$_3$ as a
function of time of immersion 94
21. Figure 3.6 Kurtosis of potential and current noise for 304L SS in
0.05 M FeCl$_3$ with time of immersion 96
22. Figure 3.7 Skewness of potential and current noise for 304L SS in
0.05 M FeCl$_3$ with time of immersion 97
23. Figure 3.8 Typical representations of coefficients obtained by wavelet
transform of the current noise time record taken 14 h
after immersion

24. Figure 3.9  
   a) EDP of current noise after 1 h of immersion  
   b) EDP of current noise after 10 h of immersion  
   c) EDP of current noise after 14 h of immersion  
   d) EDP of current noise after 23 h of immersion  
   e) EDP of current noise after 25 h of immersion  

25. Figure 4.1  
   Optical micrograph of 304 L SS used for EN measurements after oxalic acid etching  
   a) solution annealed  
   b) sensitized  

26. Figure 4.2  
   DL-EPR test plot for 304L SS,  
   a) solution annealed,  
   b) sensitized  

27. Figure 4.3  
   EN-time records taken after 150 h of immersion of solution annealed 304L SS in  
   a) 4 M nitric acid (298 K)  
   b) 8 M nitric acid (298 K)  
   c) 12 M nitric acid (298 K)  

28. Figure 4.4  
   EN-time records taken after 150 h of immersion of solution annealed 304L SS in  
   a) 8 M nitric acid (323 K)  
   b) 4 M nitric acid (323 K)  

29. Figure 4.5  
   EN-time records taken after 150 h of immersion of sensitized 304L SS in  
   a) 4 M nitric acid (298 K)  
   b) 8 M nitric acid (298 K)  
   c) 4 M nitric acid (323 K)  
   d) 8 M nitric acid (323 K)  

30. Figure 4.6  
   Electrochemical noise resistance Vs Time plots for  
   a) solution annealed 304L SS at 298 K electrolyte Temperature,  
   b) sensitized 304L SS at 298 K electrolyte temperature,  
   c) solution annealed
304L SS at 323 K electrolyte temperature, d) sensitized 304L SS at 323 K.

31. Figure 4.7 EN-time record for 304L SS in 3 M nitric acid (298K) taken after a) 85 h, b) 125 h of immersion.

32. Figure 4.8 EN-time record for 304L SS in simulated HLW (in 3M nitric acid) (298 K) taken after a) 85 h, b) 125 h of immersion.

33. Figure 4.9 Passivation in 3 M nitric acid.

34. Figure 4.10 Passivation by 3 M nitric acid and decrease in passive film stability by oxidizing ions present in simulated HLW

35. Figure 4.11 Schematic representation of cation adsorption into passive film

36. Figure 4.12 EN-time record taken 150 h of immersion of 304L SS in simulated HLW (323 K) a) solution annealed, b) sensitized.

37. Figure 4.13 Electrochemical noise resistance Vs Time plots for solution annealed 304L SS in 3 M nitric acid and simulated HLW at 298 K

38. Figure 4.14 Electrochemical noise resistance Vs Time plots for solution annealed and sensitized 304L SS in simulated HLW at 323 K

39. Figure 4.15 Typical micrographs taken after EN experiments for 304 L SS at 298 K electrolyte temperature, showing no corrosion attack for solution annealed specimen in
4 M HNO₃, b) solution annealed specimen in 8 M HNO₃,
c) solution annealed specimen in 12 M HNO₃,d) sensitized specimen in 4 M HNO₃, e) sensitized specimen in 8 M HNO₃, f) sensitized specimen in 12 M HNO₃

40. Figure 4.16 Typical micrographs taken after EN experiments for 304 L SS at 323 K electrolyte temperature, showing no corrosion attack for a) solution annealed specimen in 4 M HNO₃, b) solution annealed specimen in 8 M HNO₃, c) sensitized specimen in 8M HNO₃, d) Localized attack seen in sensitized 304L SS in 4 M HNO₃

41. Figure 5.1 Optical micrographs of the forged a) 304LN1F SS, b) 304LN2F SS c) 304LN3F SS

44. Figure 5.2 SEM of the forged a) 304LN1F SS, b) 304LN2F SS c) 304LN3F SS

45. Figure 5.3 Optical micrographs of the rolled a) 304LN1R SS b) 304LN2R SS c) 304LN3R SS

46. Figure 5.4 SEM of the rolled a) 304LN1R SS b) 304LN2R SS c) 304LN3R SS

47. Figure 5.5 EDS of the matrix and precipitate of the forged and rolled nitrogen containing 304LN1 stainless steel, showing chromium and manganese enrichment in the precipitate compared to matrix.

48. Figure 5.6 EDS of the matrix and precipitate of the forged and rolled
nitrogen containing 304LN2 stainless steel, showing chromium and manganese enrichment in the precipitate compared to matrix, and a decline in Fe content in the precipitate compared to matrix.

49. Figure 5.7 EDS of the matrix and precipitate of the forged and rolled nitrogen containing 304LN3 stainless steel, showing chromium and maximum manganese enrichment in the precipitate compared to matrix, and a substantial decline in Fe content in the precipitate compared to matrix.

50. Figure 5.8 Potentiodynamic anodic polarization curves in 1 M, 4 M, and 6 M HNO₃ (298 K) for the forged nitrogen containing stainless steels

51. Figure 5.9 Potentiodynamic anodic polarization curves in 1 M, 4 M, and 6 M HNO₃ (298 K) for the rolled nitrogen containing stainless steels

52. Figure 5.10 Potentiodynamic anodic polarization curves in 1M, 4M, and 6M HNO₃ (323K) for the as forged nitrogen containing stainless steels

53. Figure 5.11 Potentiodynamic anodic polarization curves in 1 M, 4 M, and 6 M HNO₃ (323 K) for the rolled nitrogen containing stainless steels

54. Figure 5.12 Potentiodynamic anodic polarization curves for the a) forged and b) rolled nitrogen containing stainless steels containing
three different nitrogen contents in 0.5 M NaCl

55. Figure 5.13 Typical Polarization curves for the nitrogen containing stainless steels in 1 M and 8 M HNO₃

56. Figure 5.14 Typical representation of electrochemical current and potential noise time record for 304L SS containing
   a) 0.132% N b) 0.193% N in 4 M HNO₃ taken
   b) after 8 h of immersion

57. Figure 5.15 Electrochemical noise resistance of the three nitrogen containing 304L SS in 1 M, 4 M, 8 M HNO₃ and simulated HLW

58. Figure 5.16 Spectral noise resistance of the three nitrogen containing 304L SS in 1 M, 4 M, 8 M HNO₃ and simulated HLW medium.

59. Figure 5.17 Plots showing correlations between noise resistance and spectral noise resistance for the nitrogen containing stainless steels in HNO₃ and simulated HLW medium. $R_{\text{sn}}^0$ is found to track $R_n$

60. Figure 5.18 characteristic frequencies as a function of time of immersion for the three nitrogen containing stainless steels in HNO₃ acid and simulated HLW medium.

61. Figure 5.19 Cumulative probability plots representing the distribution of frequencies for the three nitrogen containing stainless steels in HNO₃ and simulated HLW medium.
62. Figure 5.20  Typical representation of eight level decomposition using Daubechies 4 wavelet, of the current noise time record of the stainless steel containing 0.406% N in 1 M HNO$_3$, taken 20 h after immersion  174

63. Figure 5.21  Typical representation of energy distribution plots of current noise for the nitrogen containing stainless steel in 1 M HNO$_3$, showing maximum deposition of energy at D1 crystal, which is attributed to rapid current transients during passivation.  176

64. Figure 5.22  Laser Raman spectra of passive films formed on the three nitrogen containing 304L SS in 1 M, 4 M, 8 M HNO$_3$ and simulated HLW. excitation wavelength = 488 nm, laser power = 10 mw, laser exposure time = 5s, Acquisitions = 20.  178